Metals Review

January 1960

Bradley Stoughton
A.S.M. Past President
(See Article, p. 4)

TOMORROW DEPENDS ON NUCLEAR POWER

Pictured above is David W. Lillie, a nuclear metallurgist and hence one of a group that's exceedingly important, alarmingly too few.

Dave is a recognized authority on nuclear research and physical metallurgy of reactor metals. Right now he is with the General Electric Research Laboratory doing specialized long range research in nuclear materials problems. But what makes him important to you, personally, is his authorship of the Metals Engineering Institute's home study course, *Metals for Nuclear Power*.

Now you can learn, from David Lillie, many aspects of currently available information about the role of special metals in the realm of nuclear power.

And keep this in mind as you read on—*Metals for Nuclear Power* contains *authoritative* material, *current* material, *valuable* material. It was written by an expert. It is offered by the Metals Engineering Institute—a division of the American Society for Metals, a respected and honored Society with *forty years* of educational success in the metal industry.

But why should the course interest you? Here's why. What is of more interest to the metal industry than the development of metals for nuclear power?—where is the potential greater?—and will not the demand for nuclear metallurgists grow and grow as industry becomes more and more nuclear minded? That's why you should take the course. Be ready. Be current. Be able. Be available.

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Lesson 12—Radiation Damage.
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Metals Review

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CONTENTS

Important Lectures

Departments

Past President Bradley Stoughton . . . Member, Friend, Academician

Bradley Stoughton, past national president of the American Society for Metals, and professor emeritus of mechanical engineering at Lehigh University, died Dec. 30, in Bethlehem, Pa., at the age of 86.

In Bradley Stoughton's death, the academic and scientific world lost one of its leading compatriots. A stimulating personality in every walk of life, he met the duties of citizenship with zest and discharged them constructively, whether in engineering circles, in charitable enterprises, in the community, in the church or in the nation.

Prof. Stoughton, an honorary member A.S.M., and chairman of the Lehigh Valley Chapter (1934), past president of the Yale Engineering Association, past national secretary A.I.M.E., and 1931 president of the Electrochemical Society, spent many years as dean of engineering and head of the department of metallurgy at Lehigh. He was the author of a leading textbook on iron and steel which has been used for the past 40 years, and had two major inventions to his credit, a converter for making steel castings and a process for oil melting in cupolas. In 1922, as an appointee of President Harding, he wrote the report that helped to bring the eight-hour day to the steel industry.

In 1953 he was presented a citation for his contributions to the fields of metallurgy and education at the annual "Students Night" of the Philadelphia Chapter A.S.M. In 1952 he received a Department of the Army award for his contribution to the World War II effort in industrial intelligence. Members of the Lehigh Valley Chapter established, in 1939, as a spontaneous tribute to the leadership of Dr. Stoughton, an annual Bradley Stoughton Night in recognition of his contributions to the metals field. He also received the Grasselli Medal of the Electrochemical Society in 1929.

He joined Lehigh in 1923, and previous to that time had been a consulting metallurgist for 21 years. He taught at Massachusetts Institute of Technology for a time and also served as acting head of the department of metallurgy at the School of Mines, Columbia University. He spent time as a metallurgist at Illinois Steel Co., and at American Steel & Wire Co. and Benjamin Atha Co.

He was a graduate of Yale University's Sheffield Scientific School after receiving his B.S. at M.I.T. in 1896. Lehigh conferred the doctor of engineering degree upon him in 1944.

Blessed with boundless energy and high spirits, possessing a keen sense of humor and innate unselfishness, Dr. Stoughton was a welcome addition to any group. Beloved by students and faculty alike, revered by his friends and his confreres, he was in constant demand as a speaker, an adviser and a master of ceremonies.

He gave his time without stint to his students, helping them to decide the directions in which their careers should lie, counseling his colleagues, for his ability, demonstrated so often in patient trials to see the crux of a complex case, was almost uncanny and, needless to say, was invaluable to industry in both technical and legal consultations over a long period.

His intimate knowledge of the theoretical and practical problems of the manufacture of steel, combined with a charming personality, made him an outstanding figure with his students and the men of our industry. Dr. Stoughton's sympathies were never parochial, never prejudiced, always generous. Thousands of his friends will remember him with warm gratitude.

A. S. M. Metals Documentation Service Now in Operation

The new A.S.M. Metals Documentation Service started rolling on Jan. 1 with five subscribers signed up for literature searching services. Metals Documentation Service is a selecting, abstracting and searching operation covering the world's published metallurgical literature. Because searching is done by machine the service is fast, thorough and up to date.

The various types of services available from M.D.S. are listed in the advertisement on page 26, together with prices. All of the five subscriptions received so far are of the "Current Awareness" type, four of them of "specific interest" where the subscriber gives the exact details of his area of interest, and one of the "general interest" type, selected from the list of topics on p. 26.

For the present, searches are being run at two-week intervals on the experimental searching selector designed and developed at Western Reserve University during the course of A.S.M.'s five-year research project recently completed. Every two weeks each subscriber receives a pack of abstracts pertinent to his particular field of interest. A high-speed counterpart of the experimental machine, the GE 250 information searching selector, is being produced by General Electric Co. It will be delivered in March, at which time the operations will be transferred to the new machine.

Steps are also being taken at the University to implement the grant received last November from the National Science Foundation, which will provide a considerable expansion of the abstracted literature available for searching.

At present the "machine library" consists of encoded tapes which index all of the abstracts published in the A.S.M. Review of Metal Literature—a total of some 12,000 during 1960. These abstracts cover what might be called the "core of metallurgy", which can be defined for A.S.M. purposes as follows:

"Metallurgy means the arts and sciences underlying the production of any metal from its ore or concentrate; its refining, alloying and manufacture into mill shapes including foundry and forge; machining, forming or shaping operations where quality of metal or tool is critical; heat treatment and welding. It includes research into and production of conventional metals and alloys and new variations to meet special services. It includes data on properties, and on performance in any environment. It includes equipment and methods for inspection and research. It includes metallurgical education and history."

One of the purposes of the National Science Foundation grant to the W.R.U. Documentation Center was to expand this metallurgical core into some of the fields that are of peripheral interest to scientists and engineers working primarily in metallurgy. These peripheral fields will include such topics as inorganic chemistry, solid-state physics, mechanical engineering and geology. Under this grant it will require several months for the Documentation Center to build up its resources—both in journals to be abstracted and personnel to do the work, but as soon as this is accomplished subscribers to the A.S.M. Metals Documentation Service will be provided with this additional coverage. Announcement will probably be made in late spring or early summer.

Meanwhile those whose interests are strictly metallurgical, as defined above, can be provided with a complete survey of the world's literature currently being published. Inquiries are welcomed and quotations will be given promptly on any specific problem of current concern. Service can start immediately. Inquiries should be addressed to A.S.M. Metals Documentation Service, Metals Park, Novelty, Ohio.

1960 Golden Gate Metals Conference

Feb. 4-6, 1960, Fairmont Hotel, San Francisco, Calif.

Thursday, Feb. 4, Morning

HIGH-STRENGTH STEELS—I

Chairmen:
John C. McDonald,
Lockheed Aircraft Corp.
H. Theodore Sumison,
Lockheed Aircraft Corp.

Materials and Fabrication Problems of Homogeneous High-Strength Pressure Vessels, by Lawrence L. Gilbert, Aerojet-General Corp.

Fracture Theory as Applied to High-Strength Steels for Pressure Vessels, by George R. Irwin and Joseph Kies, Naval Research Laboratory

Stress Corrosion Cracking of Aircraft and Missile Steels, by E. H. Phelps, U. S. Steel Corp.

Correlation Between Burst Tests and Laboratory Tests of High-Strength Steels for Pressure Vessels, by Dean K. Hanink, General Motors Corp.

METALLURGICAL PROBLEMS IN ELECTRONICS—I

Chairman:
Lester Feinstein,
Stanford Research Institute

Metallurgical Problems in Electron Tube Technology, by Walter H. Kohl, Sylvania Electric Products, Inc.

Degassing Properties of Materials in Ultra-High-Vacuum, by N. Milleron, University of California Lawrence Radiation Laboratory

Cleaning of Metals for Use in Electronic Tubes and Semiconductors, by D. E. Koontz, Bell Telephone Laboratories

Metallurgical Problems Encountered in the Fabrication of Semiconductor Devices, by Robert E. Lorenzini and Leo B. Valdez, Rheem Semiconductor Co.

Luncheon

Address by Dan A. Kimball,
President
Aerojet-General Corp.

Afternoon

HIGH-STRENGTH STEELS—II

Chairmen:
Harry L. Anthony, Mellon Institute for Industrial Research
Carl E. Johnson,
Lockheed Aircraft Corp.

N.A.S.A. Program for Development of High-Strength Steels for Missile Motor Cases and Pressure Vessels, by William F. Brown, Jr., National Aeronautics and Space Administration

Ultra-High-Strength Steels for High-Performance Missile Cases, by G. K. Bhat, Mellon Institute for Industrial Research

Fabrication Techniques Applicable to Rocket Motors, by John H. Peters, United Aircraft Corp.

Future Applications of High-Strength Steels, by Eugene P. Klier, National Academy of Sciences

METALLURGICAL PROBLEMS IN ELECTRONICS—II

Chairman:
Lester Feinstein,
Stanford Research Institute

The Platinum Metals and Nickel in the Electronics Industry, by E. M. Wise, International Nickel Co.

Refractory Metals in Electron Tubes, by R. F. Wehrmann, Fansteel Metallurgical Corp.

Rhenium in Electron Tubes, by Chester T. Sims, General Electric Co.

Permanent Magnets in the Electronics Industry, by C. S. Maynard, Indiana Steel Products Co.

Friday, Feb. 5

USES OF ULTRASONICS IN THE METALWORKING INDUSTRY

Chairman:
Wallace J. Erichsen,
Westinghouse Electric Co.

Ultrasonic Welding, Brazing and Soldering (speaker to be announced)

Effect of Ultrasonics on Grain Growth During Casting, by D. H. Lane, Westinghouse Electric Corp.

Ultrasonic Cleaning, Pickling and Electroplating, by H. F. Osterman and T. Santa Lucia, Branson Instrument Co.

Ultrasonic Drilling, Grinding and Machining (speaker to be announced)

METAL—NONMETAL JOINING

Chairman:
Richard M. Fulrath,
University of California

Current Practices in Ceramic-Metal Joining, by Leon Lerman, Sylvania Electric Products, Inc.

Theory and Practice of Glass-Metal Sealing, by Joseph A. Pask, University of California

Ceramic-Metal Joining Problems in the Missile Industry, by J. Patrick Sterry, Boeing Airplane Co.

Afternoon

BRAZING

Chairman:
Robert C. Bertossa, Pyromet Co.

Advanced Brazing Techniques for Aircraft, Missile and Spacecraft Requirements, by John Long and George Cremer, Solar Aircraft Co.

Mechanical Properties of Brazed Joints, by George Hoppin, III, General Electric Co.

New Techniques in High-Temperature Brazing (speaker to be announced)

The Hortonclad Process of Vacuum-Pressure Brazing, by speaker from Chicago Bridge and Iron Co.

NEW TECHNIQUES FOR PROCESSING MATERIALS

Chairman:
David A. Stevenson,
Stanford University

The Application of Electron Beam Melting to the Processing of Materials, by Charles d'A. Hunt, Temescal Metallurgical Corp.

The Application of the Plasmatron to the Processing of Materials, by Ben Lohrie, Plasmakote Corp.

Techniques for Growth of 3-5 Compounds (speaker to be announced)

Evening—5:30-6:30 p.m.

COCKTAIL PARTY

Saturday, Feb. 6

METALLURGICAL AND WELDING PROBLEMS IN THE CHEMICAL AND PETROLEUM INDUSTRIES

Chairmen:
John W. Parks,
Standard Oil Co. of California
Robert D. Switters,
Standard Oil Co. of California

Stress Cracking in Exchanger and Condenser Tubing, by George A. Nelson, Shell Development Co.

Notch Sensitivity of Carbon Steels at Ambient Temperatures, by Earl R. Parker, University of California

Field Welding and Annealing of Air Hardening Steels, by Robert L. Skaggs, Standard Oil Co. of California

NEW TECHNIQUES FOR FORMING MATERIALS

Chairman:
Jess W. Wilson,
Stanford Research Institute

Application of Shear Spinning to the Fabrication of Solid Propellant Rocket Cases, by L. E. Zwissler, Aerojet-General Corp.

Spark Machining, a New Technique in Fabrication, by D. L. Curtis, Japax American Corp.

Solution of Fabrication Problems by Explosive Forming, by L. Zernow, Aerojet-General Corp.

General Chairman, Metals Conference 2020 Milvia St., Berkeley, Calif.

Reviews Explosive Forming Properties

Shown, at Left, Is J. M. Carrera, Chairman of Utah Chapter, Congratulating Louis Zernow, Aerojet-General Corp., on His Talk on "Physical Properties of Explosive Forming". R. G. Bateman, technical chairman, looks on

Speaker: Louis Zernow

Aerojet-General Corp.

Louis Zernow, assistant manager, Ordnance Division, and head of the Research Dept., Aerojet-General Corp., spoke on "The Physical Principles of Explosive Forming" at a meeting of **Utah Chapter.**

Dr. Zernow explained that while this type of metal fabrication is considered by many to be unique and apparently new, the earliest patents on this forming technique were issued prior to 1900. The peculiar problems of the missile industry have been the primary reason for refocusing attention upon this process. The factors responsible are:

1. The workpieces are becoming so large that they exceed the capacities of available presses and spinning machines. The capital investment required for an explosive forming setup is far less than the cost of a giant press.

2. The materials used in missiles are unusual in their properties and are therefore not readily manageable in ordinary forming processes. Some of these difficult materials respond very well to the explosive forming process.

3. There are frequent requirements for a few prototypes needed for experimental purposes so that specifications are in a state of flux. This makes normal tooling expensive and sometimes impractcial. In practice explosive forming can be done with a variety of die materials, including plastics and concrete.

Dr. Zernow explained that explosive forming can be treated in a scientific fashion, and that in fact this must be done, because despite its glamour the process will only survive if it is economically competitive with other forming processes.

He mentioned that any one of a large variety of explosives could be used but that at Aerojet, a liquid explosive called AEREX was found to be quite satisfactory because of homogeneity and ease of handling. He described the actual operation, indicating that the workpiece was placed on the female die, the explosive charge located at a predetermined position above the workpiece and the entire system immersed in a large water tank, so that water acted as the coupling medium between the explosive and the workpiece.

On the theoretical side, although much is known about the propagation of shocks in water, there is as yet no sound theoretical basis for predicting the response of a given workpiece material to the forces which are exerted during this process.

Interestingly enough, however, a number of examples have been found in which the apparent ductility under explosive forming exceeds the normally observed ductility. These were cited as follows:

1. Titanium and many of its alloys could be readily formed explosively even when kept at room temperature.

2. Special alloys, such as UNITEMP M-252, which are well known to be difficult to deform at room temperature by conventional methods, responded with an apparent ductility that permitted one explosive deformation to replace approximately ten successive conventional draws and anneals.

Many materials did not show the property of enhanced ductility and increased fracture strength.

In certain specific cases it has been found possible to achieve unusual reduction in the apparent elastic recovery and unusual uniformity in wall thickness. Thus it has been found possible (although rarely desirable) to control the mouth diameter of a 54-in. diameter hemispherical dome to within 0.002 in. to 0.004-in. by means of the explosive trueing process which can be applied to the pieces fabricated by other methods which fail to hold the tolerance in diameter or contour. In addition, in forming a 54-in. diameter 1.6:1 elliptical dome from ¼-in. flat sheet stock of AMS 6434, it has been found that by proper control of the process, thickness uniformity of the final piece could be held to within ±5% of the average thickness.

One of the techniques for the study of explosive forming is with high-speed motion picture cameras capable of taking pictures at rates up to 2,400,000 fps. High-speed photographs of detonation explosive charges and shock waves in water were shown.

Dr. Zernow defined an explosive as a solid or liquid which when initiated, rapidly decomposed into hot, mostly gaseous products. The detonation propagates by means of a shock wave phenomenon in which energy from the decomposing explosive is fed to the shock wave and supports it at a constant velocity called the "Detonation Velocity". This can be as high as 28,000 ft. per sec., and as low as 3000 ft. per sec. In actual practice of forming as, for example, a 54-in. elliptical dome formed from a flat sheet blank, the velocity with which the workpiece moved was between 200 and 600 ft. per sec., so that the total deformation occurred in times of the order of milliseconds rather than in microseconds, as claimed by some.

Dr. Zernow illustrated the mathematical and physical theories of explosive forming with charts and formulae. The presentation was concluded with a short movie on "Explosive Forming of Metal Shapes".

Dr. Zernow cautioned the audience not to consider explosive forming as a sure cure for all metal forming problems. He recommended its exploitation primarily in areas in which conventional processes were either uneconomical or incapable of meeting requirements.—**Reported by J. M. Boel for Utah.**

New Films

The Third Hand

A 16-mm., 14-min. sound and color film which traces the evolution of the Fisher Model 25 Gas Partitioner and its eventual use in the laboratory, is available from: Audiovisual Dept., Fisher Scientific, 717 Forbes Ave., Pittsburgh 19, Pa.

Talks on Stainless and Heat Resisting Alloys

Speaker: J. J. Heger

U. S. Steel Corp.

J. J. Heger, chief research engineer-stainless steel, U. S. Steel Corp., presented a talk on "Stainless and Heat Resistant Alloys" at a meeting in **Albuquerque.**

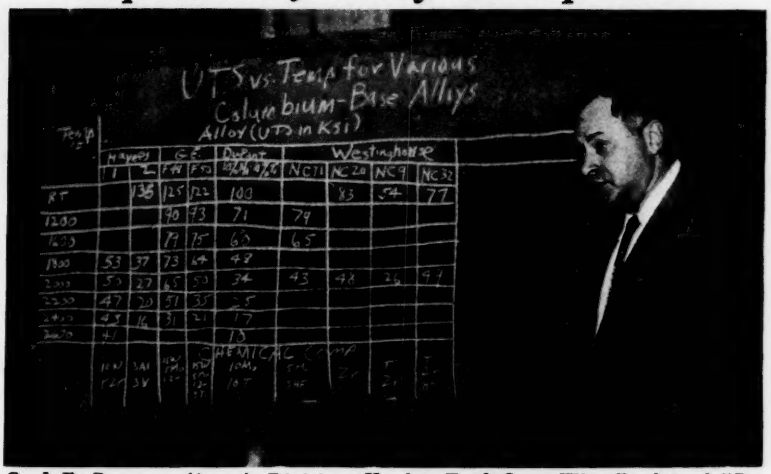
Mr. Heger gave a highly informative glimpse of the development activity in progress in the steel industry. This activity includes improvements in melting and refining practices to improve quality and lower costs, improvements in processing (sandwich rolling) to improve quality and obtain better control of dimensional tolerances, and development of new products. The ultimate success, when it comes, of any phase of this development activity cannot be attributed solely to the steel industry, because the consuming industry, by intelligently conveying its needs and its problems to the producer, prompts him into initiating his development programs. Furthermore, these programs are guided in their proper direction by the comments that are made by the consumer, who is really the best judge of the finished product. Certainly, the future development of improved processing techniques, as well as of new and improved products, can result only from close cooperation and communication between the consuming and producing industries.

Increasingly higher quality required by the consuming industry may necessitate extensive changes in melting and casting practices. Demands for steels having strengths in excess of 250,000 psi., with good ductility and toughness at this strength level, means that such steels must have a degree of microcleanliness and chemical uniformity which may be beyond that obtainable by conventional melting and casting practices. The requirements can be summarized as improved cleanliness, uniform ingot structure and rigid limits for chemical composition.

An austenitic structure is preferred for most of the applications for which stainless steel is used because this structure has better forming and welding characteristics than does a ferritic structure. Nickel has a two-fold function—to form and retain austenite and to improve the corrosion resistance of stainless steels.

Because nickel's role is that of forming and retaining austenite, any substitute for nickel must at least have this effect. The fundamental data which has been obtained from studies of the phase relationships of the chromium-manganese-nickel-nitrogen system gives us sufficient information to design a completely austenitic steel at any given nickel content.

Explains Refractory Developments



Saul E. Bramer, Aircraft Division, Hughes Tool Co., Who Explained "Recent Developments in Refractory Metals" Is Shown at San Fernando Valley

Speaker: S. E. Bramer

Hughes Tool Co.

Members of the **San Fernando Valley Chapter** heard Saul E. Bramer, Aircraft Division, Hughes Tool Co., speak on "Recent Developments in Refractory Metals".

The electronics field was probably the scene of the earliest work with refractory metals. During the past few years the aircraft industry has extensively studied the properties of molybdenum, columbium, tantalum, tungsten and their alloys.

These materials have been produced as bar and sheet stock and display several attractive properties. Generally speaking, refractories have superior strength properties at and above 1600° F.

Molybdenum has received a large portion of the attention. The pure metal has shown better high-temperature strength than the best superalloys in the 1600 to 2000° F. range. Work has also been done on alloys of molybdenum containing small additions of titanium, columbium, vanadium or cobalt. The most promising of these alloys seems to be molybdenum ½% titanium and molybdenum ½% titanium—0.7% zirconium.

Recent experiments in producing the molybdenum-titanium-zirconium alloy yielded material of much higher quality, raising the recrystallization temperature 300° F., from 2400 to 2700° F.

Several welding techniques have been used with good results. Fusion welding techniques have been successfully employed in repairing weld cracks in tail pipe sections. A 50% molybdenum-50% rhenium wire was used, working under either argon or helium atmospheres. Welds with this filler metal addition have been bent 80° over a 1-T radius at room temperature.

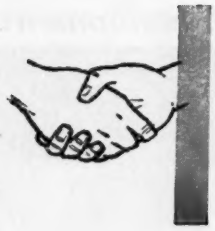
By using electron beam welding methods it may be possible to produce good room-temperature ductility and high purity weldments (less than 5 ppm. nitrogen and oxygen). Among the disadvantages of the method are the inability to weld material with thicknesses greater than ¼ in., and high part set-up time.

The use of columbium has been limited thus far due to the shortness of available alloys and limited fabrication technology. Fansteel 80 and 82 are the only alloys that are commercially available. There are other columbium alloys but these are available in limited quantities. These alloys have been sheared successfully at room temperature and excellent weldments have been produced. The newest alloy, F48, is being developed by General Electric.

Tantalum has seen only limited use so far. Two factors holding up its development and application are high cost and high density.

In summary, refractory metals exhibit highly desirable properties for high-temperature application, they can be formed and welded if the processing is carefully performed. Each new process must be considered to be an individual development program.—**Reported by John Kroehler, Jr., for San Fernando Valley Chapter.**

An evaluation of a large number of commercial size heats containing 0.03% max. carbon indicated that these low carbon stainless steels could replace the columbium-bearing 18-8 steels in applications requiring resistance to intergranular corrosion after short heating times in the sensitizing range of temperatures, such as is encountered in welding and stress relieving operations. For complete immunity over long heating periods, 0.006% carbon would be required.—**Reported by Erwin H. Mebs for Albuquerque.**



Meet Your Chapter Chairman

DES MOINES

JOHN F. SMITH, born in Kansas City, Kan., received his B.A. degree from Kansas City University and his Ph.D. in chemistry from Iowa State College. He is now associate professor of chemistry at Iowa State University, and a group leader in metallurgy at the Ames Laboratory, U.S.A.E.C. His special research and teaching interests are in intermetallic compounds, elastic constants and imperfections in solids.

Since becoming an A.S.M. member in 1950, Dr. Smith has served on the executive committee and as vice-chairman. He was a delegate to the World Metallurgical Congress in 1957. He is also active in other technical societies.

Dr. Smith is married and has a son, 11, and a daughter, 5 years old. He served as a fighter pilot in the U. S. Navy during World War II and saw considerable action in the Pacific Theater. He now holds the rank of commander in the Naval Reserve. He is also a member of the local flying club and keeps a small plane in his garage which he works on in his spare time.

LEHIGH VALLEY

HOWARD ("MIKE") O. BEAVER, JR., is a native of Lebanon, Pa. After receiving his B.S. degree in metallurgy from Pennsylvania State University he started working in the metallurgical department of Carpenter Steel Co. He moved on through plant metallurgist, melting, then production metallurgist, and is now manager of mill metallurgy.

In addition to his chapter work, which includes five years on the executive committee, Mike is a member of committees on the physical chemistry of steelmaking and electric furnace steelmaking in other technical societies. He is interested in civic affairs and a member of the Muhlenberg Lions Club.

He is married and has two children, and is very active in church and Sunday school affairs at the Alsace Lutheran Church. After serving a year at Annapolis he received a medical discharge.

FORT WAYNE

DICK W. HEMPHILL, chief metallurgist of the Ft. Wayne Division of Dana Corp., joined the company upon graduating from the University of Pittsburgh where he received his B.S. degree in metallurgical engineering. In addition to chapter activities he has been on the A.S.M. Handbook Committee working on "Selection of Steel for Gears". He is also a member of the Chamber of Commerce.

Dick joined the Air Force during World War II and was overseas nearly two years as staff sergeant in the 20th Army Air Corps. He attends Trinity Evangelical Lutheran Church and for recreation enjoys bowling and golf.

BALTIMORE

RICHARD K. WUERFEL has been a member of A.S.M. since 1938. Recent activity includes a lecture on "Heat Treating Steel" at the A.S.M. convention in Chicago in 1957. He has been on the executive committee for a number of years and a chapter officer for the last three years.

Born in Detroit, Mr. Wuerfel graduated from the University of Michigan as an electrical engineer and continued study at Wayne University night school, where he took courses in metallurgy. He began his career as an inspector at Chevrolet Motor Co. and was research metallurgist at Chrysler Motor for 17 years. He was general manager for Detroit Induction Co. and National Induction Heating Co. before taking his present position as metallurgist in the industrial electronics department, Westinghouse Corp.

Mr. Wuerfel has two girls and a boy, and is interested in Scout work. He is a rock hound and makes a hobby of geology and photography. He enjoys reading of all kinds, particularly histories of religion.

ALBUQUERQUE

DONALD R. JOHNSON was born in St. Louis, Mo., but finished high school in Carlsbad, N. M. His B.S. degree in metallurgical engineering is from New Mexico Institute of Mining and Technology and his M.S. degree in physical metallurgy was acquired at the University of Utah with high honors. During summer months, while in college, he worked at International Minerals and Chemicals Corp., and Duval Sulfur and Potash. After a year with Calera Mining Co., Salt Lake, he joined Sandia Corp., where he is now staff member in the metallurgical materials laboratory.

Previous chapter service includes one year as secretary and one year as vice-chairman and program chairman. Mr. Johnson has given technical presentations in local high schools during educational-type "Career Days". He is an avid tennis enthusiast. He and his wife are members of the First Presbyterian Church of Albuquerque.

ROCKY MOUNTAIN
(Colorado School of Mines)

GEORGE KANE is a senior at the Colorado School of Mines. An outstanding student, well in the upper 10% of his class, he is a member of Sigma Gamma Epsilon honorary earth science fraternity, Tau Beta Pi, honorary engineering fraternity, and is also very active on campus.

George was an airborne radio operator in the U. S. Air Force as a staff sergeant. His favorite recreations are skiing and tennis. He and his wife, Lois, have a daughter.

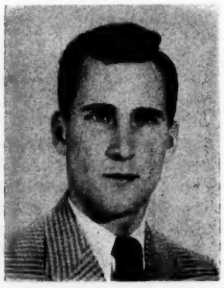
J. F. Smith

Dick Hemphill

H. O. Beaver, Jr.

R. K. Wuerfel

D. R. Johnson



Past Chairmen Attend Meeting in Tulsa

Tulsa Chapter Officers and Past Chairmen Who Attended Past Chairmen's Night Meeting Included, From Left: Dale W. Davis, Secretary-Treasurer; Albert B. Marks, Chairman; Walter O'Bannon, Jr; John E. Garol, Vice-Chairman; George R. Clay; Lauren G. Kilmer; Leslie E. Bates, Jr.; J. Homer Garrison; P. L. "Static" Willson, First Chairman (1943); Charlie Gay; Dale L. Hall; and William L. Smith. A. A. Hardie, Director of Engineering and Research, W. C. Norris Division, Dover Corp., Gave a Talk on "Modern Automated Sucker Rod Manufacturing Plant". (Reported by Albert B. Marks for Tulsa Chapter)

Discusses Ductile And Brittle Fracture

Speaker: G. M. Sinclair
University of Illinois

Members of the **Dayton Chapter** heard G. M. Sinclair, professor at the University of Illinois, discuss "Ductile and Brittle Fracture". This subject was particularly timely since the increasing requirements of reliability for aircraft, missile and nuclear reactor components has intensified the research on the problem of fracture. The importance of predicting when brittle fracture will be encountered was emphasized and examples of disastrous failures were given.

Prof. Sinclair listed the important engineering variables affecting fracture. These include the type material, microstructure, state of stress, temperature, time (stress-strain rate) and geometry of the particular piece. Each variable listed was discussed separately to provide a basic understanding of its importance. There is no simple correlation between different materials from the fracture standpoint so a basic knowledge of each material is important. Microstructural variances, such as grain size and the size and shape of included particles, have an important influence on all metals and alloys. Knowing the state of stress involved is of importance because triaxial stresses are more likely to cause catastrophic "brittle" fracture than shear stresses. Temperature also has an important bearing on the problem since many alloys become increasingly brittle at lower temperatures. The rate of applying stress or strain will change the fracture behavior of various materials and this variable cannot be overlooked. Finally, the size and shape of the item influences the fracture pattern; small parts can usually withstand higher stresses than larger ones.

The basic principles leading to the occurrence of fracture were discussed, including comparisons between standard stress-strain curves and true stress-strain curves. True stress is obtained by comparing the observed stress with the actual area obtained at the time of stress measurement. This results in a straight line as opposed to the loop obtained in the standard stress-strain curve. It is established that the true stress-strain curve increases in a uniform manner even as deformation takes place and it is the change in area which makes the standard curve misleading. Illustrations of this point were presented.

The importance of a triaxial stress was emphasized because of the importance of this factor in failures. To illustrate the importance of the third dimension in fracture, Prof. Sinclair stated that a tensile bar pulled to failure will ordinarily fracture at the point of initial deformation but if this bar is removed from the test machine when necking is first observed and machined to the point of maximum deformation (uniform diameter), the bar does not deform at the initial location if retested. In fact, if this practice of remachining to constant diameter is continued for 70-30 brass, fracture does not occur, thus emphasizing the need for a three-dimensional stress state to produce fracture in this material.

Several variables were discussed in detail as an aid in determining when brittle fracture can be expected in body-centered cubic metals. Numerous graphs were shown to illustrate the relation between yield stress and temperature on the type of fracture obtained. When observing a plot of this type, it is important to note the temperature range where the yield stress increases rapidly since this is normally an indication of the onset of low-temperature embrittlement. It is also noted that as the strain rate is decreased the yield point at a given temperature is much less, therefore decreasing the tendency for brittle fracture.—**Reported by W. A. Luce for Dayton.**

Dangerous Watches Recalled

The American Rolex Watch Corp. has asked our help in recovering several Rolex GMT-Master wrist watches of Swiss manufacture, further identified by the name "Oyster Perpetual" on the face. It appears that about 600 of these watches were made between October 1956 and November 1959, and in some unknown manner an excess amount of radioactive material was used in the luminescent markings and numerals—an amount sufficient to present a long-term health hazard to the wearer. All owners of such watches are urged to send them by registered mail to American Rolex Watch Corp., 580 Fifth Ave., New York City 36, where the face will be replaced and the watch returned promptly without charge.

Presents Sangamon Valley Charter

National President Walter Crafts Was on Hand to Present the Charter of the Sangamon Valley Chapter (Decatur, Ill., Area) to Chairman Andrew Johnson. Shown are, from left: Ted DuMond, A.S.M. field secretary; Mr. Crafts; Harold Buckholdt, treasurer; Louis Jones, secretary; Mr. Johnson; and Roy Kern, vice-chairman. Mr. Crafts presented a technical talk on "Facing the Productivity Challenge: Men and Metals of the Next Decade"

Compliments

To R. R. ADAMS, Battelle Memorial Institute, and field chief of a team of scientists and engineers which in 1955-58 advised and assisted the governing Board of the Industry Institute of Lebanon on the formulation of a program for the country's industrial development, on being made an officer of the "National Order of Cedars", one of the highest honors of the Lebanese Republic. Mr. Adams is a member of Columbus Chapter.

♦ ♦ ♦

To AUGUSTUS B. KINZEL, vice-president, research, Union Carbide Corp., on being chosen to receive the Industrial Research Institute Medal for 1960. The medal honors "outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare". Dr. Kinzel is a member of the New York Chapter.

♦ ♦ ♦

To HERMANN SCHENCK, president of the Verein Deutscher Eisenhuttenleute, who was awarded the Grande Medaille fi. Osmond, and to LEONARD BESSEMER PFEIL, director-general of the Mond Nickel Co., who was awarded the Medaille Sainte-Claire Deville, of the Societe Francaise de Metallurgie at the Annual Meeting.

OBITUARIES

HARRY LANG STRAUSS, SR., president, National Diamond Laboratory, and long-time member of New York Chapter, was fatally injured in an automobile accident on Oct. 6. Mr. Strauss was an inventor and designer of many new products relating to the metallurgy of securing diamonds in their respective holders.

♦ ♦ ♦

ALBERT P. SPOONER, metallurgical engineer in the Steel Division, Bethlehem Steel Co., until his retirement in 1957, died in August. He graduated from Lehigh University in 1915 and spent his entire career with Bethlehem Steel Co.

♦ ♦ ♦

FREDERICK G. HUGHES, a retired vice-president of General Motors Corp., died early in October in Bristol, Conn. Mr. Hughes graduated from Yale University's Sheffield Scientific School in 1900. A past national president A.S.M., Mr. Hughes was considered a pioneer in the anti-friction bearing industry and was credited with developing the basic analysis of high-carbon chromium steel which later became the industry standard.

Materials for Aircraft Structures Reviewed at Meeting in Albuquerque

Speaker: W. H. Dukes

Bell Aircraft Corp.

Wilfred H. Dukes, chief of Structures Section, Dyna-Soar Dept., Space Flight Division, Bell Aircraft Corp., spoke on "Materials for Future Aircraft Structures" at a meeting of **Albuquerque Chapter.**

With power plants now available, there is virtually no limit to the vehicle performance attainable. Speeds as high as satellite velocity were discussed by only a few people just two or three years ago. They are now the subject of everyday conversation. Such conditions impose environments on our airframes, and the materials from which they are formed, which are quite different from those with which we have become familiar.

Material requirements for high-speed airframes cannot be stated simply as a function of temperature since most of the airframe is designed by instability in compression, and geometry, loading intensity and the particular type of structure play an important part in deciding which is the best material.

The continued development of both low-density materials, such as titanium, and the high-density materials, such as the alloy and stainless steels, is still required since both have a place in future structures, their use depending upon the particular application. Higher strength, however, can only be used if there is corresponding development of structures with smaller and smaller elements, such as sandwich construction.

The development of beryllium should be vigorously pursued since it offers tremendous advantages if its difficulties of cost and lack of ductility can be overcome. The problems resulting from lack of ductility should be solvable by more refined design and analysis. By using the proper design techniques we should be able to make more brittle materials behave properly. However, it is not likely that the cost aspects can be improved sufficiently to eliminate the need for the more conventional structural materials.

Creep strength is not expected to be an important factor in selecting or developing materials for high-temperature airframes.

A most promising type of high-speed structure is protected aluminum, with insulation and cooling providing protection for aerodynamic heat. The most efficient insulation so far developed utilizes a thin metal outer wall and for this wall the material requirements are resistance to oxidation at high temperatures, with strength as a very secondary consideration.

Improved oxidation resistant coatings for the more refractory metals, and in particular, molybdenum, are desperately needed, together with a philosophy for the safe use of coated refractory metals in airframes. It is believed that the use of a thermally protected airframe, using coated refractories in nonstructural applications, supplies this latter requirement.—**Reported by E. H. Mebs for Albuquerque.**

Reviews Metal Removal Methods at Rockford

Speaker: Norman Zlatin

Metcut Research Assoc., Inc.

Norman Zlatin, vice-president, Metcut Research Assoc., Inc., spoke on "New Developments in Metal Removal" at **Rockford.**

Ceramic tools have several important advantages over the carbides. They have very high resistance to oxidation, even at elevated temperatures. Since the material is so hard, new techniques have to be developed before it can be used successfully. Because of its brittleness, it cannot be used on interrupted cuts; therefore, its use is limited at present to turning operations only, chemical milling.

Mr. Zlatin then described chemical milling, a process by which a piece of metal is shaped by dissolving off excess material in an appropriate solution while protecting the remaining surfaces with an effective mask. The chem-milling process consists essentially of five steps: the part is cleaned by immersion in a cleaning solution; the part is coated with either a neoprene or vinyl maskant, depending upon the metal; using a template as a guide, the maskant is scribed and the areas to be etched are stripped off the maskant; the part is then dipped in the etchant tank for the required length of time; the maskant is removed and the part is rinsed. At first this process was used only on aluminum parts, but now steel and other alloys are being chem-milled.

With the aid of slides, Mr. Zlatin illustrated electrical discharge machining, a series of electrical discharges occurring at a rate of 20,000 to 300,000 times per sec. between the tool and the workpiece. In each cycle the voltage is gradually built up between the tool and the workpiece until the stress becomes so high that a spark discharge occurs through the dielectric oil. Electrical discharge machining is being used for drilling, die sinking and grinding operations on electrically conductive materials.

Another metal removal process, the electrolytic method, is usually applied to grinding and cut-off work, and utilizes a combination of abrasive grinding and electrolytic erosion. The operation is performed with a conductive electrode wheel, embedded with abrasive grains that protrude slightly above the wheel surface. Both the electrode wheel and the workpiece are submerged in a conductor fluid. A continuous low-voltage current is passed between the electrode and the workpiece. In effect, this process is a reverse plating system.

In ultrasonic machining, abrasive grains are the cutting edges of the tool. They are carried in a liquid that flows between the workpiece and the tool, which is recirculated for continued use. The same types and grit sizes found in grinding wheels are used in ultrasonic machining. The extremely fast motion of the tool face produces cavitation of the abrasive liquid carrier, driving the abrasive grains against the workpiece for material cutting.

The latest metal removal method is the use of the electron beam as the cutter. A very high-voltage electron beam, similar to an X-ray beam, is focused on the part to be machined by a magnetic field to a very fine beam. The beam, in effect, produces a series of fine holes which trace out the shape of the piece of metal to be removed.

Mr. Zlatin concluded his talk on a review of high-speed machining, in which ultra-high machining speeds, from 15,000 sfm. to 180,000 sfm., are used. The workpiece is a ⅜ in. diameter slug shot out of a 30-06-caliber Mauser rifle with a 28 in. long special smooth-bore barrel. A tool is fastened to the end of the barrel, and the slug (267 grain) is fired across the fixed tool bit. By positioning the tool vertically, various depths of cut can be taken. By varying the powders, velocities can be varied from 15,000 to 180,000 fpm. **—Reported by G. W. Sandstrom for Rockford.**

Talks at Philadelphia's Temple Night

Shown at the Temple Night Meeting Held by the Philadelphia Chapter Are, From Left: Fred Cooper, Chairman, and Wolfgang H. Steurer, Chief of Engineering Materials, Convair, Who Spoke on "'Materials for Missiles and Space Exploration". Dr. Steurer discussed important material concepts based on his work in German V-2 rockets and American satellite programs

Technical Papers Invited for A.S.M. Transactions

The Transactions Committee of the A.S.M. is now receiving technical papers for consideration for publication in the Transactions of the Society and possible presentation before the next national meeting of the Society, in Philadelphia, Oct. 17 to 21, 1960.

Many of the papers approved by the Committee will be scheduled for presentation on the technical program of the 42nd National Metal Congress and Exposition.

Papers may be submitted any time up to Apr. 15, 1960, for consideration for presentation at this convention. The selection of approved papers for the convention technical program will be made in May 1960. Manuscripts may be submitted any time during the year and upon acceptance by the Transactions Committee will be processed immediately for preprinting. All papers accepted will be preprinted and made available to any members of the Society requesting them. However, the printing of an accepted paper does not necessarily infer that it will be presented at the convention.

Reprinting of accepted papers is done quarterly; notification of their availability is published in *Metals Review*.

Manuscripts in triplicate, plus one set of unmounted photographs and original tracings, should be sent to the attention of T. C. DuMond, field secretary and program coordinator, American Society for Metals, Metals Park, Novelty, Ohio.

Should it be your intention to submit a paper, please notify A.S.M. A copy of the booklet entitled "Suggestions to Authors in the Preparation of Technical Papers" will be gladly forwarded. This booklet may help considerably in the preparation of line drawings and illustrations.

Past President Gives Talk on A.S.M.

A.S.M. Past President G. M. Young, Technical Director of Aluminum Co. of Canada, Gave a Talk Entitled "A.S.M.—Its Place in Your Community" at a Meeting of Western Ontario Chapter. Shown at the Meeting are, from left: B. McNabb, secretary; Mr. Young; and G. A. Dresser, chairman

Receives Past Chairman's Certificate

Richard A. Pomfret, 1958-59 Chairman of Boston Chapter, Is Shown Being Presented a Past Chairman's Certificate by Vice-Chairman W. H. McCarty During a Recent Meeting. (Photograph by H. L. Phillips for Boston)

Discusses Corrosion at Golden Gate

E. G. Holmberg, International Nickel Co., Spoke on "Mechanisms of Corrosion and Protection Methods" at Golden Gate. Mr. Holmberg summarized the factors leading to metal deterioration by combined chemical and mechanical action. Shown are, from left: C. K. Benson, program chairman; R. L. Nichols, chairman; Mr. Holmberg; and R. O. Dean, chairman of the local chapter of National Association of Corrosion Engineers

Describes Precipitation Hardening Steels in Space-Age Vehicles

Speaker: M. E. Carruthers

Armco Steel Corp.

Texas Chapter members heard a talk on "Precipitation Hardening of Stainless Steel in Space-Age Vehicles" by M. E. (Sam) Carruthers, director of stainless research, Armco Steel Corp.

Mr. Carruthers' talk covered past developments, present usage and trends anticipated by the aircraft and missile industry through 1970. The present and future usage of alloys was graphically presented to show the adaptation of heavier alloys in thinner sheets, with reinforced construction of the honeycomb or sandwich section design, more suited to the service extremes encountered.

The 17-7 PH and the 15-7 Mo-PH steels were described as particularly suited for brazed honeycomb structures of the type used in the present B-58 and designed into the new revolutionary B-70 bomber. In addition, the need for additional high-temperature alloys was illustrated by temperature requirements of 1450° F. anticipated by 1970.

The metallurgy of precipitation hardening stainless steels was indicated to cover both steel composition and heat treatment, with both variables influencing the possible phases present and the strength requirements. The high strength was illustrated to be brought about by first forcing austenite in the low-carbon steels to transform to soft martensite and then further hardening in the temperature aging range of 750 to 1150° F.

Some of the phase changes encountered in the hardening and aging treatments were illustrated by slides showing the microstructure as viewed by the electron microscope with the phase changes substantiated by X-ray diffraction studies.

In addition to their use in high-speed aircraft and missile structures, the precipitating hardening stainless steels were illustrated in a number of nonmilitary uses. The speaker demonstrated this extended use of the alloy as due to ease of fabrication and heat treatment coupled with excellent corrosion resistance. A short resume of this usage covered dies for extruding plastics, food processing equipment, particularly in abrasive services, and use as high-temperature corrosion resistant springs, due to the high elastic properties. The amenability of the 17-4 PH steel to all types of castings has substantially expanded the use of this type of alloy in high-temperature aircraft parts and chemical service involving wear and corrosion.—**Reported by C. J. Schoppe for Texas.**

Oxygen in Steelmaking Subject at Baltimore

Speaker: A. L. Hodge
Linde Co.

A. L. Hodge, Linde Co., Division Union Carbide Corp., spoke on "Oxygen in Steelmaking" at a meeting in **Baltimore.**

Mr. Hodge listed as the No. 1 question in steelmaking today, "How can we make steel better, faster, cheapper?" This problem is becoming evermore realistic in the face of the serious increase in foreign competition and other rising costs.

As a direct result, the openhearth process of steelmaking is entering a revolution. With other processes gradually replacing openhearth practice because of their greater economy, the $2-3 billion investment, in the approximately 900 openhearth furnaces presently in existance, dictates that improved technology must be employed to improve the competitive position of openhearth practice. This, Mr. Hodge believes, will come about as the result of improved oxygen techniques and equipment.

He bases his belief on: (1) theory, (2) laboratory test data, and (3) some 15 years work done on a large number of openhearth furnaces. The detailed findings of this work are soon to be published. Briefly describing this work. Mr. Hodge showed a series of six slides which graphically presented the summation of his findings, as follows:

1. Bath carbon percent versus time (hr.) after adding hot metal (60-65% hot metal, the effect of various rates of oxygen input).
2. Oxygen consumption versus tap carbon percent (60-65% hot metal —no feed ore, the effect of various rates of oxidation).
3. Oxygen consumption versus carbon content (60-65% hot metal, the effect of various rates of oxygen input).
4. Rate of carbon oxidation versus carbon content (80% hot metal, the effect of various rates of oxygen input).
5. Heat liberated during direct oxidation versus percent carbon in bath.
6. Heat saved versus oxygen consumption.—**Reported by John H. Fuchsluger for Baltimore.**

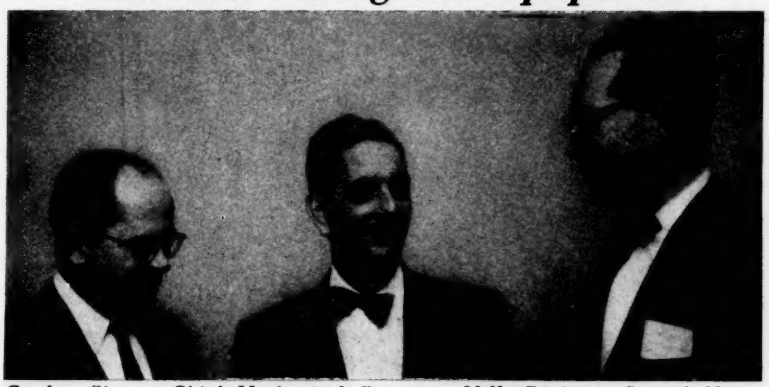
MAKE A DATE FOR DALLAS

Second Southwestern Metal Exposition and Congress Will be Held in

Dallas . . .

May 9-13, 1960

Describes Rolling Mill Equipment



Gordon Signor, Chief Mechanical Engineer, Mills Division, Scovill Manufacturing Co., Presented a Talk on "Nonferrous Cold Rolling Mill Equipment and Gages" at a Meeting in New Haven. A pre-talk visit was made by the Chapter to the Waterbury Farrel Foundry & Machine Co. Shown are, from left: F. E. J. Storm, chairman; Mr. Signor; and V. L. Miller, Jr., Lee Wilson Engineering Co., and technical chairman for this meeting

President Crafts Visits Ottawa Valley

Walter Crafts, National President A.S.M., Union Carbide Metals Co., Is Shown Being Welcomed at National Officers Night Meeting by Ottawa Valley Chairman J. O. Edwards, While N. S. Spence (Left), Vice-Chairman, and A. R. Putnam (Right), Managing Director A.S.M., Look On. Mr. Crafts gave a talk on "Facing the Productivity Challenge: Men and Metals of the Next Decade", in which he stressed the importance of the role of A.S.M. in helping to supply the rapidly expanding metal industry with the technical knowledge supplied by research centers. (Reported by Cyril Dixon)

On Worcester's Heat Treating Panel

Worcester Chapter Held a Panel Meeting on "Heat Treatment of Steel", Moderated by Howard Boyer, Managing Editor, A.S.M. Metals Handbook. Present were, from left: Carl G. Johnson, Worcester Polytechnic Institute; Arthur L. Stowe, Vanadium Alloys Steel Co., chairman; Mr. Boyer; Leonard L. Krasnow, Lodding Engineering Corp., technical chairman; Harold Mattioli, Whitin Machine Works; L. G. Field, Greenman Steel Treating Co.; and W. V. N. Baker, Draper Corp. (Report by C. W. Russell)

Presents Talk on Hot Work Die Steels

J. C. Hamaker, Jr., Vanadium Alloy Steel Co., Reviewed "New Applications of Hot Work Die Steels for Aircraft and Structural Uses" at a New Jersey Chapter Meeting. Shown are, from left: Dr. Hamaker; Oscar Miller, technical chairman of the meeting; and Anthony Scafati, chapter chairman

Speaker: J. C. Hamaker, Jr.
Vanadium Alloy Steel Co.

J. C. Hamaker, Jr., manager, research and metallurgical engineering, Vanadium Alloy Steel Co., spoke on "New Applications of Hot Work Die Steels for Aircraft and Structural Uses" at a meeting held by the **New Jersey Chapter.**

Dr. Hamaker briefly reviewed the growing need for steels in the ultra-high-strength range and the rapid progress in the past 10 years. He concentrated his talk on the medium alloy steels used as ultra-high-strength steels.

The basic steel in this group of 5% chromium alloys was first developed by V. P. Gill in 1932. Current steels are modifications of this alloy. The advantages outlined were the ability to obtain secondary hardening for stress relief and retained austenite removal on high-temperature tempering, as well as the ability to maintain strength at elevated temperatures.

Numerous properties and applications illustrated that the 5% chromium alloy is now used in production of aircraft and missiles in the 280,000 to 300,000 psi. strength range.

Since the steel is not of the stainless variety, surface protection treatments, such as nickel-cadmium diffused plate, hot dip aluminizing, heat resistant paint and nitriding, were discussed. Fabrication techniques and precautions for working with the steel to obtain maximum properties were reviewed.

Dr. Hamaker concluded by evaluating the future of steels in the high hardness range and indicated that a yield strength level of about 390,000 psi. appears to be the presently attainable in high alloy steels by heat treatment alone.—**Reported by A. Schwarzkopf for New Jersey.**

Gives Report on Status Of European Wire Mills

Speaker: R. S. Worth
John A. Roebling's Sons

Members of the **Delaware Valley Chapter** heard Raymond S. Worth, manufacturing manager, Wire Mills Division, John A. Roebling's Sons, speak on "European Wire Mills". He and Chapter past-president H. A. Godfrey were privileged this past summer to tour wire mills in England, Austria, Italy, Switzerland and France, and visited 16 wire mills, five research and development centers and one machinery manufacturer.

Mr. Worth first observed that European managers were more than willing to open their gates to Americans, but were reluctant to exchange information regarding production techniques with their European competitors. For this reason, Mr. Worth indicated reluctance to disclose or discuss practices or techniques which might be considered as confidential.

Mr. Worth related that all signs in England and on the continent point to a miraculous postwar recovery. He indicated that capital is available and, that as local demand is satisfied, the Anglo-European producer more and more will seek the lucrative American market.

Definite signs of modern production techniques were discussed. In rod rolling, for example, increased line speed and larger coil weights mark the modern trend. A continuous rod mill was reported to produce 3,500 tons per week under the most rigid quality control standards. Postwar mills are designed in the functional straight lines of material flow, and these mills are manned by a capable and aggressive management supported by excellent engineering staffs.

As seen by Mr. Worth, the real threat to the American wire industry is seated in the low cost of labor, both in England and on the continent. Labor costs in England were reported as approximately one-third those in the United States, and even a smaller fraction in Europe. Despite this, Mr. Worth reported that labor-management relations are good, work stoppages are rare, quality and quality control are excellent and business, in general, is good.—**Reported by F. M. Edwards for Delaware Valley.**

Hold Student Night

R. F. Thomson, head of the metallurgical engineering department, General Motors Corp., presented a talk on "Automotive Gas Turbines" at the Students Night Meeting held by the **Washington Chapter.**

During the meeting Dennis Andrew Witmer, a metallurgy student at Maryland University, was awarded a scholarship. George Washington and Maryland Universities were well represented at this meeting.—**Reported by E. Y. C. Tsao for Washington.**

WILLIAM H. EISENMAN LIBRARY COLLECTION

In the months immediately after Bill Eisenman's death a number of contributions were made to a memorial fund. The A.S.M. Board of Trustees has now decided that the money, with future additions, shall be used to purchase old, rare and important books on metallurgy. This "William H. Eisenman Collection", to be treasured in the library at Society Headquarters, might eventually become so notable as to attract scholars and historians from all over the world. Chairman of the administrative committee is the well-known savant, Cyril S. Smith, professor at the Institute for the Study of Metals at Chicago University. The nucleus of this collection will be on display at the ceremonies dedicating A.S.M.'s new headquarters building at Metals Park in September 1960. Further contributions for this purpose by admirers of our late Secretary will be welcomed, either in money or incunabula.

CHAPTER MEETING CALENDAR

Akron	**Feb. 17**	Sangininti's Restaurant		Magnetic Particle and Dye Penetrant Inspection
Baltimore	**Feb. 15**	Engineers Club	**K. H. Steigerwald**	Electron Beam Techniques
Boston	**Feb. 5**	MIT Faculty Club	**Walter Crafts**	New Alloy Steels
British Columbia	**Feb. 9**			Quality Aspects of Vacuum Melted Alloys
Buffalo	**Feb. 11**	Continental Inn	**R. H. Johnson**	Trouble Shooting in Machine Shops
Calumet	**Feb. 9**	Phil Smidt's	**W. D. Pellini**	Application of Materials to Thermal and Space Vehicles
Chicago	**Feb. 8**	Furniture Club	**G. E. Pellissier**	Simplified Electron Metallography of Steels
Chicago-Western	**Feb. 15**	Old Spinning Wheel	**H. W. Highriter**	The Refractory Metals—Applications and Fabrication
Cleveland	**Feb. 1**			Zay Jeffries Night
Columbia Basin	**Feb. 17**			Quality Aspects of Vacuum Melted Alloys
Columbus	**Feb. 3**	Battelle Memorial Institute	**Francis Boulger**	Machining Steel
Dayton	**Feb. 10**	Engineers Club	**L. Miller**	Problems in High-Speed Flight
Delaware Valley	**Feb. 13**			Ladies Night
Eastern New York	**Feb. 9**			Thermo-Electric Power and Materials
Golden Gate	**Feb. 4-6**	San Francisco Conference		Golden Gate Metals Conference
Hartford	**Feb. 9**	Indian Hill Country Club	**C. P. Williams**	Explosive Forming
Indianapolis	**Feb. 15**		**L. E. Gibbs**	Copper-Base Alloys—Properties and Uses
Inland Empire	**Feb. 16**			Quality Aspects of Vacuum Melted Alloys
Jackson (Mich.)	**Feb. 16**	Arbor Hills Country Club	**Joseph Bird**	Explosive Forming
Kansas City	**Feb. 17**	Golden Ox	**Bob Criger**	Russian Journey
Long Island	**Feb. 17**	Patricia Murphy's	**W. A. Pennington**	Diffusion and Transport of Carbon in Ferrous Metals
Louisville	**Feb. 2**		**F. B. Foley**	Mode of Failure of Metals at Elevated Temperatures
Mahoning Valley	**Feb. 13**	Mural Room		Ladies Night
Miami	**Feb. 8**	Woody's Steak House	**E. J. White**	Explosive Forming of Metals
Milwaukee	**Feb. 16**	City Club	**P. E. Cary**	Modern Quenchants
Montreal	**Feb. 1**	Queen's Hotel		Executive's Night
Muncie	**Feb. 9**	Ball State Student Ctr.	**J. Maranchik, Jr.**	Influence of Metallurgical Factors on Machinability at High Hardness Levels
New Haven	**Feb. 18**	Rapp's Paradise Inn	**E. Gordon**	Nuclear Metallurgy
New Jersey	**Feb. 15**	Hotel Essex House	**Ralph Bailey**	Continuous Casting of Copper-Base Alloys
New York	**Feb. 12**	Plaza's Terrace Room		Dinner-Dance
North Texas	**Feb. 11**		**F. L. LaQue**	Joint Meeting With A.S.T.M. and N.A.C.E.
Oak Ridge	**Feb. 10**	K. of C. Hall	**E. R. Parker**	Recent Developments in Materials Research
Ontario	**Feb. 5**	Prince George Hotel	**H. P. Tardif**	Rockets and Missiles
Oregon	**Feb. 12**			Quality Aspects of Vacuum Melted Alloys
Philadelphia	**Feb. 26**	Engineers Club	**Carl Zapffe**	Science, Religion and World Events
Phoenix	**Feb.**	Bud Brown's Barn		Ladies Night
Pittsburgh	**Feb. 11**	Gateway Plaza	**C. L. McCabe**	Applying Thermodynamics to Metallurgical Practice
Puget Sound	**Feb. 10**			Quality Aspects of Vacuum Melted Alloys
Purdue	**Feb. 23**	Lafayette	**F. R. Morral**	Cobalt in Antiquity and Modern Times
Rhode Island	**Feb. 3**	Johnson's Hummocks Grill		Explosive Forming
Richmond	**Feb. 9**	Downtown Club	**E. A. Gulbransen**	Crystal Growth and Stress Corrosion
Rochester	**Feb. 8**	Manger-Seneca Hotel	**Thomas B. King**	Russia Through the Eyes of a Metallurgist
Rockford	**Feb. 24**	Hotel Faust	**J. A. DeFries**	How Quality Control Has Improved Toolsteel
Saginaw Valley	**Feb. 9**	High Life Inn	**W. L. Mosher, Jr.**	Light Metals in the Automotive Industry
St. Louis	**Feb. 18**	Elks Club	**Panel**	Requirements, Employment and Training of the Materials Engineer
Southern Tier	**Feb. 24**			Annual Dinner in Cooperation With T.E.C. National Engineers Week
Syracuse	**Feb. 2**	Onondaga Hotel	**C. M. Ladd**	Beryllium Fabrication
Texas	**Feb. 2**		**Al Albrecht**	Machinability of Metals
Toledo	**Feb. 11**	Maumee River Yacht Club	**C. L. Faust**	Finishing and Plating
Tulsa	**Feb. 2**	Alvin Plaza Hotel	**W. A. Hammer**	Heat Treating Alloy and Toolsteels
Utah	**Feb. 10**		**Students from University of Utah**	How Materials React to Explosions and Explanation of Processes Involved in Reduction of Iron Ores
Vancouver Island	**Feb. 11**			Quality Aspects of Vacuum Melted Alloys
Washington	**Feb. 15**	All States Hotel	**R. H. Aborn**	Burgess Memorial Lecture
West Michigan	**Feb. 15**			Plant Tour
Wilmington	**Feb. 10**	Fabian's Restaurant	**J. J. Moran, Jr.**	High-Temperature Corrosion and Oxidation
Worcester	**Feb. 10**	Hickory House	**Panel**	Metal Stampings
York	**Feb. 10**	York	**J. G. Jackson**	Patents and the Modern Engineer

F. W. Young, Jr., Solid State Division, Oak Ridge National Laboratory, Gave a Talk on "Nuclear Reactors as Tools for Metallurgical Research" at a Meeting in Richmond. Shown are, from left: J. A. Burke, Jr., past chairman; Dr. Young; C. L. Brooks, chairman; and W. F. Smith, secretary

Describes Uses Of Nuclear Reactors

Speaker: F. W. Young, Jr.
Oak Ridge National Laboratory

"Nuclear Reactors as Tools for Metallurgical Research" was the subject of a talk by Frederick W. Young, Jr., Oak Ridge National Laboratory, at a recent meeting of the **Richmond Chapter.**

Neutron activation analysis, radioactive tracer and neutron diffraction techniques were discussed. The use of a nuclear reactor for altering the properties of metals in a controlled manner by the introduction of defects such as vacancies and interstitials was described.

Dr. Young indicated that neutron activation analyses, where applicable, can be used with a great deal of sensitivity and accuracy. For example, during the preparation of copper whiskers by vapor decomposition of copper iodide, a minute quantity of iodide was carried over. When analyzed by neutron activation, 3×10^{-9} grams of iodine were found in the whisker. To accomplish this analysis, the sample was irradiated with neutrons and the iodine then determined by a radioactive count.

Self-diffusion can only be studied using radioactive tracer methods. Since the advent of nuclear reactors, radioactive tracers of almost all of the elements are available, and now self-diffusion in a large number of metals is being studied.

A beam of neutrons is diffracted by a lattice in a manner similar to X-ray diffraction. Since the neutrons are scattered by the nucleus, the scattering power of atoms is not a function of their position in the periodic table. Therefore, the positions of the light atoms in a lattice can be determined by neutron diffraction, whereas this is not possible with X-ray diffraction (e.g., hydrogen in metal hydrides). The effects of magnetic moments on the scattering of neutrons were illustrated.

Dr. Young discussed the applications of neutron bombardment for solid state physics studies. An interesting result occurred when pure metals were irradiated with fast neutrons. The vacancies and interstitials which were produced resulted in pronounced changes in mechanical and physical properties. By irradiating at liquid helium temperatures so that all the damage was frozen in and then studying the annealing behavior, information was obtained on the properties of interstitials and vacancies. When impurities were present, the annealing rate was altered.

The resolved yield stress of copper can be increased by about two orders of magnitude by room temperature irradiation with fast neutrons. A yield point is generally introduced in metals by nuclear irradiation. Neutron irradiation also causes a change in Young's modulus.

Studies of alloys indicated that irradiated metastable samples were less stable than nonirradiated samples in a comparable metastable state. Diffusion occurred more rapidly in the irradiated samples.

Summarizing the effects of neutron bombardment on the mechanical properties of metals and alloys, Dr. Young indicated that tensile strength, yield strength and transition temperatures can be raised by neutron bombardment. Percent elongation and percent reduction of area are lowered. Among alloys which showed marked changes in properties after neutron bombardment were 1100 aluminum alloy, normalized carbon steel, hardened and tempered alloy steel and austenitic steel. The biggest improvements were noted in the yield strengths.

Prior to Dr. Young's talk, United States Steel's movie "Mackinac Bridge Diary" was shown.—**Reported by W. W. Berkey for Richmond.**

Cites Effects of Energy Revolution

A. Allan Bates, Vice-President, Research and Development, Portland Cement Assoc., Discussed "Some Effects of an Energy Revolution" at a Meeting Held by Rocky Mountain Chapter. Shown are, from left: Dick Schaffer, chairman; Dr. Bates; and H. P. Leighly, technical chairman

Predicts Progress of The Sixties

Irwin H. Such, Editor-in-Chief, Steel Magazine, *Gave a Talk Entitled "Metalworking Meets the Competitive Sixties" at a Meeting of Boston Chapter. Shown are, from left: W. H. McCarty, vice-chairman; Mr. Such; and A. D. Bach, technical chairman. (Photograph by H. L. Phillips)*

Speaker: Irwin H. Such
Steel Magazine

"Business will be good for the next 18 months if widespread labor problems are settled", according to Irwin H. Such, editor-in-chief of *Steel* Magazine, at Sustaining Members Night meeting in **Boston,** in a talk entitled "Metalworking Meets the Competitive Sixties".

Mr. Such predicted the steel industry will pace 1960's economic gain by turning out 120 million ingot tons of steel, about 33 million tons more than will be produced in strike-plagued 1959 and 3 million tons more than was made in 1955, the industry's best year.

Contributing to a better year in 1960 will be estimated U. S. auto production of 7 million units, a bigger year for appliances, a 33% gain in freight car orders, higher consumption for oil and gas lines and a good year for construction.

He forecast that before the end of the decade the steel industry will find its present capacity of 150 million tons is not enough. He said to look for a new round of expansion (10 million tons) by 1965 and a second 10 million by 1970.

For metalworking the next decade promises to be the most prosperous we have ever experienced. If the post-war rate of per capita expansion continues, it will be reasonable to expect metalworking sales of $300 billion by 1970 versus $140 billion in 1959 and $146 billion in 1960.

Mr. Such looks for radical changes inside the home of the 1960s: You can expect dish and clothes washers that will clean with sound waves in cold water without the aid of soap or detergents; cooking centers that provide both high-speed electronic and conventional heat; a flat screen television set that can be plugged into outlets in every room.

Some people will call the next decade the "Soaring Sixties", others the "Fabulous Sixties". It should also be called the "Competitive Sixties" because they will be neither fabulous nor soaring for the people and organizations not adapting to the changes ahead through vision, creative thinking and planning.

We are in a period of dog-eat-dog competition in the U. S. and on a world-wide basis, including the Communist orbit. The aluminum industry is going all out to capture a slice of the market traditionally held by steel and, naturally, steel is resisting.

Materials are only a part of the competitive picture. Management is taking a new look at production costs and obsolescence. Automation, for instance, is now available in single machine tools turning out small lots. Machines like these will permit American manufacturers to compete with foreign plants employing low-paid workers and with less efficient equipment.

This country has long held to the philosophy that the individual should share fully in the fruits of his labor. This means that we have the many-pronged problem of meeting the needs of the individual, modernizing and expanding our production facilities and maintaining a full war-time economy.

Commenting that Mr. Khruschev's visit to the U. S. melted the ice a little, Mr. Such also declared that the cold war will go on—we will go right on spending more than $40 billion a year on preparedness.

In spite of world tensions, the wondrous progress in technology promises a better way of life for all people. The changes coming in the way we live represent just one small facet of the rapid advance in technology resulting in the development of new materials, new processes and new products.—**Reported by Daniel Black for Boston.**

Tour Dominion Forge Plant at Windsor

Sixty-Four Members and Guests of the Western Ontario Chapter Attended a Dinner Meeting at Which 25 Educational Course Certificates Were Given to Last Year's Students by N. Eley, Chrysler Corp. Following the meeting a tour was made through Dominion Forge Ltd. Shown are, from left: J. McMurdie, Steel Co. of Canada Ltd.; Mr. Eley; R. Waddington, Dominion Forge Ltd., and F. G. Cross, Chrysler Corp. (Reported by F. Miller)

Speaks on Future of Men and Metals

National President Walter Crafts Spoke on "Men and Materials of the New Decade" at a Meeting of New Jersey Chapter. Shown are, from left: A. Scafati, chairman; Mr. Crafts; A. Kinney, technical chairman; T. C. DuMond, national field secretary; R. Thorne, secretary; and R. Raudebaugh

Speaker: Walter Crafts

Union Carbide Metals Co.

National Officer's Night brought national president, Walter Crafts, associate director-research, Union Carbide Metals Co., A.S.M. managing director, Ray Putman, and field secretary, Ted DuMond, to a meeting of the **New Jersey Chapter.** In addition, new national treasurer, Bob Raudebaugh, a member of the Chapter, was on hand.

Following an account by Mr. Putman of the new headquarters and a description of the various functions of the national organization, a talk was given by Mr. Crafts on "Men and Metals of the Next Decade".

The core of this talk centered around the highly accelerated rate of new scientific discoveries in the field of materials and the effect of this acceleration on insuring that a material with nearly optimum combination of properties could be obtained for each new engineering need in the space age, which has generated immense competition between materials industries and companies and has resulted in a greater ratio of research and development spending to plant and equipment outlays in the metalworking field than for all of manufacturing.

Mr. Crafts gave such examples as multilayer coatings, each with its specific function, on missiles such as the Vanguard; the use of ductile high-tensile steels in rocket cases; and the burgeoning importance of new material properties, such as neutron absorption in the field of atomic metallurgy. In addition to this competition in the end use of new materials, the same has become true of the material sources and production methods. For instance, the ocean floor presents a rising source of competition to normal sources of metals such as manganese; minor metals production might receive unexpected competition from a company which develops a new mine for a primary ore with a larger secondary metal ore concentration.

Mr. Crafts gave similar examples in the production field, such as gas and oil as blast furnace fuels, the LD steel converter, oxygen use in the openhearth, electron beam melting, vacuum melting and refining, steel extrusion, slip casting, plasma jet welding, honeycomb structures and numerically controlled machining.

Finally he stressed the relationship to this accelerated progress in the intellectual field with respect to ideas and their communication. The importance of operations research and the general theories of idea development were outlined.—**Reported by R. E. Liebendorfer for New Jersey Chapter.**

Powder Metallurgy Is Topic At St. Louis Chapter Meeting

Speaker: W. L. Batten

Vanadium Alloys Steel Co.

William L. Batten, manager, powder metallurgy department, Vanadium Alloys Steel Co., gave a talk entitled "Powder Metallurgy Looks to the Future" at a meeting held by the **St. Louis Chapter.** His talk covered the types of powder available and the properties of these powders. The properties are related to the mechanical properties of prealloyed powder compacts.

Mr. Batten's slides showed the various type products made by powder metallurgy methods. A long but educational question and answer period followed the talk.

The Chapter presented sustaining member certificates to the Benerson Corp. and the West St. Louis Machine & Tool Co. at this meeting, and awarded speaker awards to John O'Meara, Banner Iron Works, and Jack Bodine, Bodine Pattern & Foundries Co., in appreciation of their lectures given during the spring educational course.—**Reported by David E. Murray for St. Louis.**

Mineral Garden Continues to Grow

A.S.M. Managing Director, Ray Putnam, Observes Streaks of Elemental Copper in a Native Copper Specimen Being Pointed Out by Tone Brasunas, Metals Engineering Institute Director, and "Curator" of A.S.M.'s Mineral Collection. The specimen weighs approximately 100 lb. and was presented to A.S.M. by the Michigan College of Mines and Technology Chapter, which obtained it from Calumet Hecla, Inc. Other A.S.M. chapters will undoubtedly add to the growing mineral collection. Dr. Brasunas is hoping to learn of an available meteorite for the A.S.M. garden

Stresses Importance of The Design of Products

Speaker: J. A. Burgard
Columbia-Geneva Steel Division

J. A. Burgard, Columbia-Geneva Steel Division, spoke at a meeting of **Vancouver Island Chapter** on "The Application of Metallurgical Principles to Design of Products".

In speaking of products, whether a watch spring, a garbage can, a truck frame, a pipe line or washing machine tub, it is necessary to be specific. Each different product may require as many as 1000 clear, concise concepts of processes, materials and finishes.

Because of the difficulty in covering all materials and metals used in production, Mr. Burgard discussed the least complicated products. For example, if the finished product is a tank, the following questions arise:

Is it a 40-gal. galvanized steel hot water tank?

Is it a 250,000-bbl. oil storage tank erected in the field?

Is it for acid storage?

Is it for shipping combustible gas in interstate commerce?

As fast as uses for a tank are named, numerous metallurgical problems which need to be solved come to mind before a satisfactory tank can be produced within the economic limits of a competitive market.

The same may be true of products subjected to abrasion—first we must establish the nature of abrasion.

Is it caused by falling rocks, or coal, involving impact and abrasion?

Is it the sliding-cutting type, such as on conveyor chutes?

Is it the blasting type of abrasion?

Is it caused by high-velocity fluids carrying abrasive particles?

Materials which are best suited to withstanding these various types of abrasion may include wear resisting steel, low-alloy, high-strength steel, carburized steel, stainless steel, white iron, glass, rubber and rubberized cloth and lead.

Problems arise too when design engineers do not have a good metallurgical background or do not call in a metallurgist in time to forestall complex problems during the design stage.

Safeguarding life and property requires consideration in design. For example, the aircraft industry must assure the accuracy of tests on parts and sub-assemblies conducted in the laboratory and wind tunnel before the plane is flight tested. The thoroughness with which metals and other materials are tested and evaluated by the aircraft industry has led manufacturers of other products to adopt some of the same standards of quality.

The metallurgist is also concerned with production tools and methods. For example, choice of proper material for dies can save money and increase efficiency in hot punching, broaching and other forming operations. Product design may also involve welding techniques.

Fortunately, outstanding metallurgists of our day have given us the tools with which to evaluate the alloys we wish to consider for the product being designed. These men have made invaluable contributions to the store of fundamental metallurgical knowledge which today's metallurgists can call upon to help them make ready decisions insuring more satisfactory products.

Cites Railroad Uses of Nuclear Energy

Shown at a Meeting of Peoria Chapter Are, From Left: W. H. Lenz, Caterpillar Tractor Co.; R. O. Bardwell, Denver & Rio Grande Western, Who Spoke on "Nuclear Energy Railroad Applications"; J. E. Jass, Director of Engineering, and C. S. Black, Assistant Purchasing Agent, Caterpillar

Speaker: R. O. Bardwell
Denver & Rio Grande Western

Robert O. Bardwell, nuclear scientist, Department of Research, Denver & Rio Grande Western, spoke on "Nuclear Energy in Railroad Applications" at a meeting of **Peoria.**

According to Mr. Bardwell, research is the salvation of industry. He pointed out that nuclear radiation is useful to the railroad industry in determining the soundness of welded rails and other structures, the density of cross ties and soil and the content of water in the soil.

Nuclear radiation has played an important role in the preservation of food.

Radioisotopes have been used in the railroad industry for the measurement of wear on moving parts in the diesel engine, for analyzing the efficiency of fuel and the reasons for broken journals on freight cars. Radioisotopes also have a future as a source of power for signal devices, remote switching mechanisms and switch lamps.

The Russians have been seriously considering atomic power for railroads and so have we, irrespective of the social and political aspects of the problem. Mr. Bardwell pointed out that atomic power for moving locomotives and freight cars is worthy of investigation when one considers that railroad locomotives represent one-eighth of the installed electrical capacity in the United States.

Mr. Bardwell explained that the ground rule for any industrial problem is economics and since atomic power costs the same in units of energy available as coal, a re-evaluation of coal as a source of power is being carried out. By pretreating coal with atomic radiation, the coal disintegrates fine enough to make it suitable for burning in diesel engines when mixed in small quantities with diesel fuel.

The meeting was concluded with a short film explaining the treatment of coal with atomic radiation and a question and answer period.—**Reported by W. T. Bott for Peoria.**

Students Given Awards

Roy E. Tinney, Washington State University, presented a talk on the Albrook Hydraulic Laboratory at the University during the Annual Student Award Meeting of the **Inland Empire Chapter.**

Three students from Washington State University and three from the University of Idaho received awards, presented by S. A. Duran, chairman of the department of metallurgy at Washington State, which will help them to continue their studies in metallurgy.

Winners of $500 scholarships from the A.S.M. Foundation for Education and Research were Milton D. Petersen, Idaho, and Donald P. Hansen, Washington. Darrell Erb, Washington, and Eugene S. Henry, Idaho, received honorary membership awards from the Foundation. Dennis G. Hargreaves, Idaho, and W. L. Johnson, Washington, were presented with the annual Inland Empire Chapter Award.

Talks in Tulsa on Patent Law

Robert F. Davis, a Patent Attorney With the Law Firm of Stevens, Davis, Miller and Mosher, Presented a Talk Which Was Entitled "Patent Law" at a Meeting Held Recently by the Tulsa Chapter. Shown are, reading from left: Mark M. Bowman, Jr., past chairman of the chapter; Mr. Davis; and A. B. Marks, Well Surveys, Inc., present chapter chairman

Speaker: Robert F. Davis

Stevens, Davis, Miller and Mosher

Robert F. Davis, patent attorney, Stevens, Davis, Miller and Mosher, was the featured speaker at a meeting of the **Tulsa Chapter.**

Mr. Davis dealt first with the fundamentals of patent law, including the reasons and philosophy behind the provision for patents in the U. S. Constitution, and the manner in which the constitutional provision has been implemented to advance science in the useful arts.

He explained what can be patented as distinguished from the many things that cannot properly be patented, and noted the differences among patents, design patents, trademarks and copyrights.

He outlined a way in which those concerned should attempt to determine whether or not a particular invention is worth patenting from a practical standpoint. The steps that are necessary to obtain a patent, and the steps necessary to utilize that patent to its best advantage were presented by Mr. Davis.

Patent interferences, which are the procedure by which the Patent Office attempts to determine which of two applicants for a patent on one invention should receive the patent, were also discussed. In this connection, Mr. Davis pointed out the desirability of keeping proper notebooks and of taking prompt action to get patent applications on file on inventions that are likely to prove important.

Mr. Davis went into the matter of litigation over patents, the reason for this litigation, and the reasons why it is as costly and time consuming as it is.—**Reported by Robert L. Kerwin for Tulsa.**

A.S.M. is the largest publisher of books for the metals industry in the world.

Draw Record Attendance

A very successful educational course sponsored by the **Milwaukee Chapter** on "Machining Modern Metals" drew a near record 360, 360, 310 and 325 attendance in four weekly lectures. Certificates for 100% attendance were issued to 197.

A. O. Schmidt of Kearney & Trecker Corp., spoke on "Principles and Measurement of Machinability", W. H. Splinter, Republic Steel Corp., spoke on "Machinability of Ferrous Materials", D. G. Jones, Kennametal, Inc., spoke on "Carbide Tool Materials" and the last session featured a lecture on "Machinability of Copper-Base Alloys" by Q. F. Ingerson of Ampco Metal, Inc., and a lecture on "Machinability of Aluminum and the Light Metals" by F. F. Stretmater, Reynolds Metals Co.—**Reported by R. A. Huseby for Milwaukee.**

At Chicago, Chicago-Western Meeting

Walter Crafts, A.S.M. President, and Associate Director of Technology, Union Carbide Metals Co., Spoke at a Joint Chicago and Chicago-Western Meeting. Shown are, from left: Paul K. Zimmerman, Chicago-Western chairman; Allan Ray Putnam, managing director A.S.M.; Mr. Crafts; and James F. Schumar, Chicago-Western. Mr. Crafts gave a talk entitled "Facing the Productivity Challenge: Men and Metals of the Next Decade"

Speaker: Walter Crafts

Union Carbide Metals Co.

Walter Crafts, president A.S.M., and associate director of technology, Union Carbide Metals Co., spoke at the National Officers Night meeting of the **Chicago** and **Chicago-Western Chapters.**

Mr. Crafts discussed "Facing the Productivity Challenge: Men and Metals of the Next Decade". The general state of the metal industry shows that 43% of manufacturing employees are in the metalworking industry and this group produces 46% of the total manufactured goods. Mr. Crafts projected this into the future to show that there will be an increasingly greater need for technical people and technical knowledge. Then Mr. Crafts proposed that in 1975 the metalworking industry will constitute one-half the gross national product, about $375 billion as compared with only one-third of the present gross national product.

Many technical developments are in progress in the metal industry and more will be quickly forthcoming. One important change, explained Mr. Crafts, is that metal men in the present day are selling metal properties and not just metal. Other changes that would occur, such as new methods of forming, welding, machining, and the use of the plasma arc, were mentioned.

Allan Ray Putnam, managing director A.S.M., gave a short introductory talk prior to Mr. Crafts. He outlined and directed the attention of the audience to the many benefits included in the A.S.M. membership and about the large amount of information disseminated by the Society.—**Reported by John Byrnes for Chicago-Western.**

Gives Views on Advances In Materials Research

Speaker: Earl R. Parker
University of California

Earl R. Parker, past national trustee A.S.M., from the University of California, presented a talk at a meeting of the Albuquerque Chapter on "Recent Developments in Materials Research".

Until recently, metal research was sponsored mostly by the producers. During the past decade, however, four or five times as much research has been done by users as by producers. Two notable examples are semiconductor materials and high-temperature materials. With users doing 75% of the research, there is no particular emphasis on certain materials but the best is sought out.

Regarding the mechanical behavior of materials, what makes things break? Only recently have we clearly begun to understand how cracks get started.

The fracture follows the cleavage planes at low temperatures. At high temperatures the fracture path follows a shear plane. Shear fractures follow slip planes. Ten years ago we knew this and it was the best answer that we could get with a microscope. Now we know that there are many fracture processes. Fractures do not occur spontaneously over a large volume of material. There are two stages—the nucleation of the crack and the growth of the crack. In ductile materials fracturing starts in the center of the section and grows with stress.

To reason how cracks get started one must theorize as to what happens at the atomic scale. With the electron microscope at 50,000 magnification, it is possible to see where a defect exists in the lattice. Also, precipitation and nucleation can be studied with the electron microscope. One way to prevent cracks from forming is by making the grain size very small.

Twin boundaries are as effective barriers to flow as grain boundaries. Slip bands prove to be barriers.

A shear crack is one that is on a plane at right angles to the plane that is slipping. Where dislocations pile up at a grain boundary a cleavage crack starts.

The best barriers are materials, such as iron carbide, that do not flow. Strengths over 400,000 psi. are easily possible with a 0.47% carbon steel, for example. Short slip distances are the key to high strength. —**Reported by E. H. Mebs for Albuquerque.**

A.S.M. has created the Metals Engineering Institute, the home study school of the metals industry.

Reports Properties of Air-Age Metals

"New Metals for Structural Applications in Aerospace Vehicles" Were Reviewed by R. J. Runck, Defense Metals Information Center, Battelle Memorial Institute, at a Meeting of the Los Angeles Chapter. Shown at the speakers' table are, from left: William Ward, vice-chairman; Mr. Runck; H. A. Curwen; and John Lynn, the technical chairman of the meeting

Speaker: R. J. Runck
Battelle Memorial Institute

Members of the **Los Angeles Chapter** heard a talk on "New Metals for Structural Applications in Aerospace Vehicles" by Roger J. Runck, manager of the Defense Metals Information Center, Battelle Memorial Institute.

Mr. Runck discussed beryllium, rhenium and the refractory metals of Groups IVa, Va and VIa of the periodic table—titanium, zirconium, hafnium, vanadium, columbium, tantalum, chromium, molybdenum and tungsten. He first explained the purpose and duties of the Defense Metals Information Center, an operation formerly known as the Titanium Metallurgical Laboratory. Now that its work is enlarged in scope, the purpose of Defense Metals Information Center is to assist those in defense industries to get technical information. Mr. Runck urged people engaged in defense work to make use of this service. The work at Battelle is with new metals, both ferrous and nonferrous, and the refractory metals for structural applications are receiving particular attention at this time.

While the production of beryllium, rhenium and the refractory metals is a very small part of the total annual production of metals, the attractive properties of these materials have stimulated much research and development work in coordination with actual and potential applications in aerospace vehicles.

Steel production is rated at 90 million tons per year. The annual production capacity of some of the refractory metals is as follows: titanium, up to 40,000 tons; tungsten, 5000 tons; molybdenum, 1500 tons; and some of the others, just a few hundred tons.

The price of refractory metals varies greatly. The following approximate per pound prices illustrate this: titanium, $1.50; tungsten and molybdenum, $3-4; zirconium, $4-6; beryllium, columbium, tantalum, vanadium and hafnium, $40-70; and rhenium, $900. The melting points of the metals discussed go from the relatively low melting beryllium (2340° F.), up through tungsten, which is the highest melting metal known (6170° F.). Most of the beryllium produced today comes from beryl which contains beryllium oxide, silicon oxide and aluminum oxide. Beryllium resources in the United States are approximately 50,000 tons of contained beryllium, but less than 500 tons of this is available at present prices and with present recovery processes. Most of the beryllium ore used in the United States is imported. Beryllium is used in the nosecone of the Project Mercury ballistic capsule (approximately 1000 lb. of beryllium for each nosecone).

Tungsten, because of its high thermal conductivity, low thermal expansion and high melting point, is attractive for rocket nozzles. Tantalum, with 10% tungsten, is attractive because it is easier to fabricate than tungsten and is fairly resistant to some of the solid rocket propellants. In this respect it is not as good as tungsten but is considerably better than pure tantalum.

When plotting stress rupture against temperature at 100 hr., titanium alloys come into prominence at 500° F., beryllium is good up to about 1000° F., but has low ductility, molybdenum and columbium alloys are good for 1800-2500° F. Above 2500° F. about all that is left is tungsten. Tantalum alloys also may be developed that will be useful above 2500° F. —**Reported by Robert F. Metz for Los Angeles.**

MEI MAKING RAPID PROGRESS

METALS ENGINEERING INSTITUTE NEWS

Enrollments in the Metals Engineering Institute, the home-study school of the metals industry, have risen even more sharply than optimistic predictions indicated. Over 3000 personnel have been enrolled since M.E.I. began operations less than three years ago.

Thirty chapter-sponsored classes have already been held, or are in progress, and many more are scheduled to begin in the spring of 1960. By far, the most popular course is the Elements of Metallurgy. Other courses have a moderate degree of popularity, these include Heat Treatment of Steel, High-Temperature Metals, Stainless Steels and Fundamentals of Ferrous Metallurgy.

M.E.I. courses are also serving a vital need as in-plant training programs in well over 40 industrial companies throughout the U.S.A. The acceptance of M.E.I. by industry is very encouraging and is attributed in part to the recent accreditation of M.E.I. by the National Home Study School, the accrediting agency recognized by the United States Office of Education. However, acceptance by industry is attributed for the most part to the excellence of the courses and the great satisfaction resulting from the new-found knowledge and increased performance by M.E.I. students in their industrial duties. Enrollments in M.E.I. have already exceeded 3000 students and well over 1200 individuals proudly display M.E.I. certificates.

In addition to the 18 courses which are currently available, M.E.I. has just added a 19th course, entitled Machining of Metals. This comprehensive course on machining was written by William Backer, formerly of the Cincinnati Milling and Machining Co., and now with the Norton Co., Worcester, Mass.

Within a few months, Course 41, entitled Principles of Heat Treating, will be available. This course will discuss various heat treating operations, ranging from stress relief to solution quenching, and will cover heat treatment of age hardenable alloys, ordinary steels, low, medium and high-alloy steels, including toolsteels, and new precipitation hardening stainless steels. This fall three other courses will be ready, including Course 37, entitled Welding Metallurgy, Course 12, Testing and Inspection of Metals, and Course 14, Corrosion of Metals.

Persons interested in any of the courses for themselves, or for some of their co-workers, either on an individual or in-plant training basis, are urged to write to M.E.I. Headquarters, Metals Park, Novelty, Ohio, for details. The idea of making up a composite course from M.E.I. courses is rapidly gaining in popularity. For instance, Crucible Steel Co. has recently initiated a M.E.I. course for 22 of their employees by judicious selection of individual lessons from three standard M.E.I. courses. It is a tailormade course ideally suited to their needs.

M.E.I. is now considering the preparation of additional lessons, which are presently unavailable, even in textbooks, so that a need in industry can be filled effectively with a minimum of delay. M.E.I. encourages inquiries and suggestions and would be happy to discuss whatever training needs you, or your company, might have, and make appropriate recommendations.

Graduates From Blast Furnace Course

Walter A. Raymond, technical director of Landers Mora Cia, Medellin, Colombia, South America, is the first student to graduate from the Metals Engineering Course 3, entitled Iron Blast Furnace Operations. He maintained an over-all average of 92, completing the course in ten months, which is par for M.E.I. courses.

Mr. Raymond is 40 years old, is married and has three children. He holds a metallurgy degree from Brooklyn Polytechnic Institute.

Although he is a graduate metallurgical engineer, Mr. Raymond tells us that he felt the need for additional background on blast furnace operations, particularly on the operating level. "I am happy to say that the course has fulfilled its purpose to me", says Mr. Raymond.

The Iron Blast Furnace Operations Course provides a practical analysis of the blast furnace process and covers such controversial subjects as high top pressure, wet and dry blast air and calcite versus dolomite fluxing stones. It was written by Charles E. Agnew who has more than 50 years experience with blast furnace operations and is a well-known consultant on the subject.

(For further information, see p. 2.)

During the Recent Graduation Exercises Held by the Rochester Chapter, John Hoffer, Foreground on the Right, Presents a M.E.I. Certificate to One of the 13 Men Who Completed Course 10, Heat Treatment of Steel. This was one of the smallest M.E.I. classes sponsored by an A.S.M. chapter but it was nonetheless well received by the students who were enrolled

EMPLOYMENT SERVICE BUREAU

The Employment Service Bureau is operated as a service to members of the American Society for Metals and no charge is made for advertising insertions. The "Positions Wanted" column, however, is restricted to members in good standing of the A.S.M. Ads are limited to 50 words and only one insertion of any one ad. Address answers: c/o A.S.M., Metals Park, Novelty, Ohio, unless otherwise stated.

POSITIONS OPEN

Midwest

HEAT TREATING EXECUTIVE: Capable of taking complete charge and setting up and operating job shop heat treat facilities in Cleveland area. Modern equipment and building, highly rated company, well financed. Can offer stock ownership or profit participation. Prefer someone with a following in this field. We will respect your confidence. Send resume and photo with reply. Box 1-5.

STEEL SALESMAN: For cold finished bars. Excellent opportunity. College trained, under 35 preferred. Man selected will be trained for mill sales in Detroit area. Replies will be held confidential. Write full particulars including residence and telephone. Box 1-10.

FOUNDRY MANAGER: Graduate engineer, metallurgical or mechanical, experienced in iron or steel foundry melting or molding and supervision. Age 25-35 preferred. Excellent opportunity in high-quality iron foundry, 100 employees, located in Missouri. Box 1-15.

REFRACTORY AND REACTIVE METALS: Openings at both senior and junior metallurgist level in production, engineering and process development activity. Please forward resume detailing education, experience and salary requirement. All replies confidential. Employment Office, Universal-Cyclops Steel Corp., Drawer 153, Bridgeville, Pa.

FERROUS PROCESS AND PHYSICAL METALLURGISTS: With one to five years experience in iron and steel industry, to work with expanding research and development organization in large and extremely diversified steel producing facility. Openings available for metallurgical engineers familiar with and having working knowledge of blast furnace, sintering plant, various steel producing processes, rolling mills and product physical metallurgy. B.S. degree required. If you desire a challenging assignment with an opportunity for professional growth and advancement, send complete resume: Box 1-20.

GRADUATE ENGINEER: Opening in central metallurgical department of corporation with multiplant operation for manufacturing automotive transmissions, axles, universal joints and clutches. Desires graduate engineer under 35 with several years experience in automotive or allied industry. Duties will include metallurgical analysis of material returned from field. Salary commensurate with experiences. Location, Toledo, Ohio. Box 1-25.

TEACHING FELLOWSHIPS IN METALLURGY: Available in department of metallurgical engineering of midwestern university, starting September 1960. Opportunity to obtain M.S. and Ph.D. degrees. Box 1-50.

East

METALLURGIST: B.S. degree, recent graduate with up to three years experience preferred. Duties would include supervision of applied research on projects related to nonferrous investment castings. Plant located in New England. Salary commensurate with qualifications. Box 1-30.

METALLURGISTS: Medium-size progressive powder metallurgy parts concern has opening for metallurgist with B.S. or advanced degree for research, product development and production control. This is an excellent opportunity for aggressive individual. The concern has a number of interesting and important projects that require immediate attention. Excellent opportunity for recognition and freedom to supervise own work. Firm is well financed and is dedicated to long-term growth and development. Box 1-35.

SALES ENGINEER: Experienced, with following for Metropolitan New York and New England, for carbide tools. Salary, expenses and commission. Send resume in complete confidence. Box 1-40.

METALLURGIST: Progressive nationwide metal fabricating concern has excellent opening for experienced metallurgist at one of its eastern divisions. Nonferrous background preferred but not absolutely essential. Should have some experience in metal production processes and mill problems. Salary open. Please send complete resume. Box 1-45.

YOUNG ENGINEER: Welding Research Council, a cooperative research organization, requires a young graduate engineer, with at least two years experience, for technical secretary. Opportunities for advancement and experience in research writing and publications; also, contacts with outstanding scientists and engineers. Starting salary $8000. Send resume of education, experience and background to: Assistant Director, Welding Research Council, 29 W. 39th St., New York 18, N. Y.

NUCLEAR ENGINEERS AND PHYSICISTS: To establish core nuclear and thermal characteristics and to perform shielding and hazards analyses; METALLURGICAL ENGINEERS: To select and specify equipment and materials for nuclear power plants; MECHANICAL ENGINEERS: To design and develop precision components, such as control rod drive mechanisms and core components for nuclear power plants; MECHANICAL ENGINEERS: To perform mechanical design analyses, stress calculations, heat balance and cycle efficiency studies. College degrees with several years pertinent experience required. Send complete resumes and salary requirements to: G. Y. Taylor, Administrative Services, Alcoa Products, Inc., Schenectady 5, N. Y.

Government

RESEARCH METALLURGISTS: $6285-12,770 per year, mostly in Washington, D. C., area, in various federal agencies. For full information, write to: Executive Secretary, Board of U. S. Civil Service Examiners, National Bureau of Standards, Washington 25, D. C.

Canadian

ASSISTANT PROFESSOR: Two openings: one for a specialist in the physical chemistry of iron and steelmaking, the other for a

physical metallurgist. Ph.D. or equivalent required. Teaching duties include both undergraduate and graduate classes. Research interest is essential. Write: Chairman, Dept. of Metallurgy and Metallurgical Engineering, McMaster University, Hamilton, Ont., Canada.

West

FELLOWSHIPS AND RESEARCH ASSISTANTSHIPS: For advanced work leading to a doctoral degree in physical metallurgy. Course work offered in kinetics, thermodynamics, physics of metals, nuclear metallurgy, theory of alloying and X-ray diffraction. Research facilities available. Deadline for application is Mar. 1, 1960. Write: Dept. of Metallurgy, University of Denver, Denver 10, Colorado.

POSITIONS WANTED

METALLURGIST: B.S. degree (honor student), completing graduate work toward M.B.A. degree, age 28, married, with seven years experience in design, development and manufacture of nuclear fuel components—fuel alloys, fuel elements, core assemblies. Diversified experience in all related fabrication techniques. Seeks position with management potential either in process development or production. Box 1-55.

METALLURGICAL TECHNOLOGIST: Graduate Ryerson Institute of Technology, 1956, age 25, single. Four years experience in development work of galvanizing and aluminiz-

Metallurgists study

After samples of irradiated UO_2 were heated at a constant temperature for definite periods and the evolved gas trapped, aliquoted, and counted by gamma ray spectrometric techniques, the theoretical amount of Kr^{85} produced was calculated and compared to experimental results...

Rare gas diffusion is just one of the important areas of reactor metallurgy under study at the Bettis Atomic Power Laboratory where metallurgical engineers are involved in the advanced state of the art as it applies to radiation studies, new fuel developments and cladding material, and the application of existing materials to nuclear systems.

RARE GAS DIFFUSION IN UO_2

If you are a metallurgist and are interested in pursuing a career in reactor and nuclear system metallurgy and are a U.S. citizen, write to: Mr. M. J. Downey, Dept. B-19, Bettis Atomic Power Laboratory, Westinghouse Electric Corporation, P. O. Box 1526, Pittsburgh 30, Pennsylvania.

$$f = \frac{C}{C_o} = 1 - \frac{6}{\pi^2} \sum_{n=1}^{\infty} \frac{1}{n^2} \exp\left(-n^2 \pi^2 \frac{Dt}{a^2}\right)$$

BETTIS ATOMIC POWER LABORATORY

Westinghouse

A Major Breakthrough . . . .

ASM—MDS

The American Society For Metals Announces Today's Most Noteworthy Advance in Modern Research Tools

METALS DOCUMENTATION SERVICE
FEATURING
A MACHINE THAT FINDS INFORMATION

The American Society for Metals now has an "electronic brain" which contains all available current world literature pertaining to metals. The machine can sort this literature according to topic. This means that your firm can receive, every two weeks, a list of digests which will tell you the whereabouts of all published information on any metals subject. Any published information—throughout the world—which you and your firm should have, can be at your fingertips. You tell ASM the topic in which you are interested, anything in that area which appears in print will be on the report you receive every two weeks.

This service can save your firm the time and money now spent in manual literature searching—the energy devoted to page-by-page inspection of metals engineering publications. It can eliminate duplication of research. This new ASM service can build for your firm a complete, current and comprehensive library of specific metals information.

RETURN THIS COUPON FOR MORE FREE INFORMATION

MAIL TO: METALS DOCUMENTATION SERVICE—AMERICAN SOCIETY FOR METALS—METALS PARK—NOVELTY, OHIO

M.D.S. CAN HELP YOUR FIRM FOUR DIFFERENT WAYS

1. **CURRENT AWARENESS SEARCH—SPECIFIC INTEREST**
This service provides prompt, current information on a specific metals topic. Complete digests of technical articles on your topic are sent to you every two weeks.

2. **CURRENT AWARENESS SEARCH—GENERAL INTEREST**
This service provides the same two-week report as described above, but on topics of wide interest. Since many subscribers may desire the same reports, this service is offered at a lower price.

3. **BIBLIOGRAPHIC SEARCH**
This service prepared on demand. It provides digests of technical articles on any metals topic by making one search of all past literature. It is not a continuing service.

4. **CONDUCT YOUR OWN SEARCH**
The electronic tapes and coded punched cards used by the "electronic brain" are available by special arrangement. This will allow you to set up a searching machine to conduct your own search.

CHECK THE SERVICE OR SERVICES THAT WILL HELP YOU MOST

☐ Please send more information on a CURRENT AWARENESS SEARCH— SPECIFIC INTEREST to cover the following topic _____

_____

☐ Please send more information on a CURRENT AWARENESS SEARCH— GENERAL INTEREST to cover the topic(s) I have checked below:

- ☐ Fabrication of sandwich structures
- ☐ Use of oxygen in steelmaking
- ☐ Heat Treating in controlled atmospheres
- ☐ Welding Type 347 stainless steel
- ☐ Vacuum melting and pouring
- ☐ Use of toolsteel compositions in aircraft and missiles
- ☐ Explosive forming
- ☐ Zone melting
- ☐ Brittle fracture of steel
- ☐ Cold forming processes
- ☐ Bright electroplates
- ☐ Use of radioactive isotopes in metallurgy

☐ Please send more information on a BIBLIOGRAPHIC SEARCH to cover the following topic _____ for the past____years.

☐ Please send more information on how I may obtain and use coded punched cards and coded tape in conducting my own searches.

NAME: _____ TITLE: _____ COMPANY: _____

STREET & NO.: _____ CITY: _____ ZONE: _____ STATE: _____

MR-1

ENGINEERS and SCIENTIFIC PERSONNEL

- METALLURGICAL
- CHEMICAL
- CERAMICS
- MECHANICAL
- PHYSICAL CHEMISTS
- METALLURGISTS

Why not consider employment with America's leading beryllium producer? Because of expanding commercial and military applications for all beryllium products, our total employment has more than doubled in the past two years. We expect extensive continued growth and can offer these challenging career opportunities in a dynamic industry.

ELMORE, OHIO ENGINEERING DEPARTMENT

PROCESS ENGINEERS

Metallurgical or Chemical Engineer. Process engineering responsibilities on ore melting, heat treating and sulfating operations. Minimum of three years experience in pyrometallurgy desirable.

Chemical Engineer. Process engineering responsibilities relative to the wet chemical production of beryllium hydroxide and beryllium oxide from ore. Interest, background, and training in unit operations of thickening, filtrating, crystallizing, etc., highly desirable. Experience not necessary.

Mechanical or Metallurgical Engineer. Process engineering responsibilities relative to the attritioning and sintering of metal powder. Background and interest in powder metallurgy and/or mechanical design experience with metal powder attritioning equipment desirable. Minimum three years experience.

Mechanical Engineer. Process engineering responsibilities for methods analysis for production machining of complex metal parts from blanks on a large scale. Must be able to set up effective methods from the viewpoint of minimum scrap generation and minimum man-hour requirements. Minimum five years experience.

Metallurgical Engineer. Background in the casting of metals, with training or background in the physical chemistry of non-metallic inclusion formations, dissolved gases in metals and their effect on the casting properties of non-ferrous alloys and properties of sheet obtained from such castings. Three years experience required.

Mechanical Engineer or Metallurgical Engineer. Process engineering responsibilities in rolling of non-ferrous alloys. Should be capable of specifying processing steps for various beryllium copper alloys and to develop optimum processing sequences. Three years experience required.

CENTRAL ENGINEERING

Require five to six mechanical or chemical engineers for new metallurgical and chemical plant equipment design, construction and installation. Experience in plant layout and plant engineering highly desirable, particularly in chemical plant, metallurgical vacuum melting and non-ferrous rolling mill area. Specialty openings in the field of ventilating engineering for air contamination control. Four positions require minimum of three years experience; two positions require no experience.

METALLURGICAL DEVELOPMENT

Metallurgical Engineer. Background in non-metallic inclusions and gases in metals for development work on non-ferrous casting processes. No experience required.

Mechanical or Metallurgical Engineer. Strong background and interest in testing methods and testing methods development to design and evaluate new tests for beryllium, beryllium copper alloys and other special materials. Three to five years experience required.

Customer Service Metallurgical Engineer. Experienced in failure and application analysis, for service to beryllium copper and beryllium customers. Must be able to diagnose and analyze material deficiencies in diverse applications. Three years experience required.

ADMINISTRATIVE ASSISTANT

Business administration graduate with engineering training to serve as administrative assistant in a large engineering department. Will be concerned with control of capital equipment expenditures, new plant construction and other administrative responsibilities. Experience desirable but not necessary.

SUBMIT RESUMES IN CONFIDENCE TO: R. Y. Heimsath, Personnel Director
Brush Beryllium Co., Elmore, Ohio
Phone no. 2-2745

★ ★ ★ ★ ★ ★ ★ ★ ★

CLEVELAND, OHIO RESEARCH AND DEVELOPMENT DEPARTMENT

ENGINEERING AND SCIENTIFIC PERSONNEL NEEDED FOR EXPANDING RESEARCH & DEVELOPMENT DEPARTMENT

MATERIALS RESEARCH

Metallurgists, physical chemists or ceramic engineers, PHD preferred, but others considered for basic and applied research in the following areas:

ALLOY DEVELOPMENTS—beryllium rich, dilute alloys (Copper, Nickel-base alloys etc.), and brazing alloys.

HIGH TEMPERATURE COMPOUNDS

FORMULATION AND SINTERING STUDIES IN CERAMICS AND POWDER METALLURGY. EVALUATION OF PROPERTIES OF HIGH TEMPERATURE ALLOYS AND COMPOUNDS

FABRICATION DEVELOPMENT

Project Engineers and supporting personnel with B.S. or advanced degrees are wanted in each of the following areas:

Rolling development program for establishing techniques of manufacturing thin sheet and foil.

Formability studies on Sheet & Plate.

Joining of beryllium to itself and other metals, with special emphasis on heli-arc welding method and brazing procedures.

Fabrication of air frame components and composite bodies of high temperature metals.

SUBMIT RESUMES IN CONFIDENCE TO: J. B. Meyers, Brush Beryllium Co.
4301 Perkins Avenue, Cleveland 3, Ohio
Phone no. ENdicott 1-7161

THE BRUSH BERYLLIUM COMPANY

PLANTS: ELMORE, OHIO—CLEVELAND, OHIO—READING, PA. Executive Offices: Cleveland, Ohio

ing sheet steel. Presently head of pilot plant operations. Desires more challenging position in related or other metallurgical development. Will relocate, preferably in Canada, but will consider U. S. offers. Available Mar. 2, 1960. Box 1-60.

DEVELOPMENT MANAGER OR EXECUTIVE: With 20 years diversified experience in responsible metallurgical positions. Experience encompasses steel melting, rolling mills, laboratory supervision, heat treating, welding, finishing plant fabrication practices and coatings. Presently chief metallurgist for multi-plant concern making exacting products. Large experience in wire and wire products, ferrous metallurgy, toolsteels, heat treatment, fabrication practices, joining, etc. Prefers Midwest or East. Box 1-65.

METALLURGIST: Recent college graduate seeks interesting position with established company. Experienced in chemical analysis of ferrous materials but wishes to enter field of physical metallurgy. Presently engineer in training with well-known company. Box 1-70.

METALLURGIST: B.S. and M.S. degrees, age 32, married. Seven years experience. Master's thesis in corrosion research. Four and one-half years experience with tools and toolsteels, including all phases of heat treatment, metallography, testing, customer complaints, photography, report writing and specification writing. Box 1-75.

PHYSICAL METALLURGIST: Ph.D. degree, age 36, family. Eight years experience in research and industry in electronics, alloy development, high-temperature materials, powder metallurgy. Supervisory experience and technical report writing. Desires opportunity to contribute to technical progress of growing company. Prefers Southern Connecticut or New York City area. Box 1-80.

ENGINEERING ASSISTANT: With seven years experience. Desires position in medium-size or small company in metals or associated industry. Has wide experience in heat treating, nondestructive and destructive testing, failure analysis, ferrous and nonferrous metals, high-temperature alloys. Will relocate, travel. Box 1-85.

METALLURGIST-ADMINISTRATOR: B.S., M.S. degrees, with 18 years experience in production, research and development, primarily in materials for the electronic industry. Strong organization and administration background based on solid knowledge of materials. Seeks position in administration, liaison, or technical services. East Coast or midwestern metropolitan area preferred. Box 1-90.

METALLURGICAL ENGINEERING GRADUATE: Specific duties: Represent company on technical committees and communicate orally as well as written with customer technical staffs. Quality control and answering product failures and complaint reports. Should be familiar with forging and heat treating processes and equipment. Metallurgical development for new product line. Location in St. Louis with limited traveling. Please send qualifications to:
Box 1-115, Metals Review

METALLURGIST: B.Met.Eng., with 11 years diversified experience in ferrous and high-temperature alloys, including customer liaison, sales. Strong background in process metallurgy involving melting, casting, conversion, fabrication; credited with technical papers and patents. Seeks position in administration, product development/sales or technical service. West Coast preferred. Box 1-95.

ENGINEER: Age 36, family, licensed in Ohio, with 12 years experience in chemistry, metallurgy, high-temperature brazing, jet and rocket engine manufacturing processes. Training and experience in statistical design and analysis of experiments. Desires position in applied research. Box 1-100.

MAKE A DATE
FOR DALLAS

Second Southwestern Metal Exposition and Congress Will be Held in

Dallas . . .
May 9-13, 1960

OWENS-CORNING
FIBERGLAS

Needs
METALLURGICAL ENGINEERS

To conduct basic and applied research projects in the development of high temperature alloys and precious metals which have applications in forming glass fibers. A B.S. in Metallurgy is required, preferably with two years experience in related fields.

As part of a planned expansion program, Owens-Corning Fiberglas Corporation is building a research laboratory at the new Fiberglas Technical Center near Granville, Ohio, located 27 miles east of Columbus. The Technical Center will comprise the Basic and Applied Research Laboratory of which the Metallurgical Research Laboratory is a part.

In addition to the metallurgical research facility, Owens-Corning Fiberglas Corporation maintains two production metallurgical departments for reworking precious metals and a small foundry for casting high temperature alloys.

Persons interested should send a brief resume of training and experience to Robert M. Woodward, Manager, Metallurgical Research, Owens-Corning Fiberglas Corporation, Newark, Ohio.

THE METALS DIVISION
KELSEY-HAYES COMPANY
has technical openings in

VACUUM METALLURGY

Expansion by the leading vacuum induction melted alloy producer calls for the addition of several metallurgists and engineers to the technical staff. The positions include independent work on a number of challenging projects such as:

- **Specialty alloy development**
- **Melting and casting process development**
- **Working, fabrication, and data evaluation of specialty alloys**

Applied research, development, technical control, and customer service work are areas where you can apply your talents with the Metals Division. The atmosphere is informal and stimulating, the work challenging, the future promising. To join the leader in the rapidly growing vacuum metallurgy field,

please send your resume in confidence to:
Dr. I. S. Servi, Director of Research

METALS DIVISION
KELSEY-HAYES COMPANY
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METALLURGISTS

Excellent opportunity to grow with a progressive expanding company for graduates with B.S. degree and up to five years experience, to carry out work in laboratory programs on extraction, alloying, melting, extrusion, welding, rolling.

Salary commensurate with qualifications and experience.

Send resumes in confidence or call collect—

Richard M. Quimby,
Personnel Director
The Beryllium Corp.
P. O. Box 1462
Reading, Pa.

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2 scientists

IMPORTANT POSITIONS With
REPUBLIC AVIATION'S
Recently Organized
MATERIALS DEVELOPMENT DEPARTMENT

PHYSICIST, PHYSICAL CHEMIST or METALLURGIST
MS preferred, BS with satisfactory experience acceptable. Practical experience in design, construction and operation of high temperature equipment and measurements. Will assume responsibility for programs involving the determination of high temperature physical properties of materials.

PHYSICAL METALLURGIST
PhD preferred. MS acceptable. With strong theoretical background and interest in research and development in the high temperature field.

Send resume to: Mr. George R. Hickman, Technical Employment Manager

REPUBLIC AVIATION
Farmingdale, Long Island, New York

METALLURGY

Opportunities in Advanced Reactor Development. The new groups being formed around key members of The Knolls Atomic Power Laboratory's professional staff afford metallurgists who join us now unusual opportunities to work in close liaison with acknowledged leaders in reactor technology. You are invited to inquire about current openings in: **Materials Application.** Initiate and execute R&D programs of nuclear materials. BS in Metallurgical Engineering or Chemistry. **Fuel Element Materials.** To conduct development investigations in area of fuel element materials. Should have MS or PhD in Metallurgy and 3-10 years related experience or PhD in Physical Chemistry. **Process Metallurgy.** Prepare programs and recommend compatible metallurgical systems and processes to obtain low-cost, high endurance nuclear fuels. Should have BS in Metallurgical Engineering and 2-5 years related experience. **X-Ray Diffraction.** To conduct studies in powder identification, phase diagrams and lattice parameter measurements. Should have BS in Chemistry or Metallurgy and 3-5 years related experience. **Ceramic Materials Development.** Perform development investigations in the area of ceramic fuel element materials. Qualifications should include PhD in Ceramics and up to 3 years experience in applied ceramics. **Quality Assurance.** Act to assure adherence to process of quality requirements during fabrication of nuclear fuels and cores; provide technical leadership for field inspectors. Should have BS in Met E, Chem. Physics or Chem E with 5-10 years manufacturing experience, primarily in quality control. **Also Openings in:** Physical Chemistry / Metallography / Irradiations Engineering / Vacuum Techniques / Welding & Fabrication.

ADVANCED DEGREE PROGRAM KAPL is now considering recent graduates in ME, Met, Met. E, ChE, Physics, EE, Nuclear E. and Marine E. for its advanced degree program in nuclear engineering in conjunction with Rensselaer Polytechnic Institute. Applicants should have strong interest in nuclear field and must have graduated in upper 10% of their class. Selection of candidates will be completed by April 1; classes begin September, 1960. Write for further details.

U.S. Citizenship Required

Please send your resume in confidence,
including salary requirement, to Mr. A. J. Scipione, Dept. 43-MA

Knolls Atomic Power Laboratory
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GENERAL ELECTRIC
SCHENECTADY, N. Y.

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This is a regional event of national significance, important to YOU because it demonstrates new developments, new tools, new techniques and processes . . . important to YOU because it brings into focus every ingredient of the Southwest's upsurge in industrial progress. Dallas is a convenient centerpoint in a vast industrial trade area that spans a 600-mile radius from Albuquerque to St. Louis to Birmingham . . . so Dallas is the place to be in May of 1960 for an opportunity to increase your knowledge of metals and processes . . . to attend important technical sessions of ASM and the Society for Nondestructive Testing. Tour the colorful exhibits of leading southwestern and national firms. Plan now to attend.

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Chicago—WAbash 2-7822